ENCLOSURE E

CABLE AND CABLE ALTERNATIVE SYSTEMS AND EQUIPMENT

1. Introduction. This enclosure provides general planning information on cable (wire and fiber optic) and radio systems TSSR that can be employed in place of CX-11230 coaxial cable.

2. Field Wire and Cable Systems

    a. General Description. The wire and cable systems in current use for tactical communications systems include WF-16/U telephone cable, CX-4566/U 26-pair cable, and CX-11230 coaxial cable.

    b. WF-16/U Telephone Cable. The WF-16/U telephone cable consists of two pairs twisted to form a four-conductor cable and is available in 1-mile lengths weighing 62 lbs. Each pair has an attenuation (wet) of 2.7 dB per mile at 1 kHz. The conductors are made of copper-cadmium alloy stranded. Each pair is color coded and one pair ridged for touch identification. This four-conductor telephone cable is used to interconnect the tactical automatic switches and their subscribers. Technical characteristics are found in Table E-1.

    c. CX-4566/U Telephone Cable Assembly. The CX-4566/U cable consists of standard conductors, six copper and one steel #24 AWG wire. Each end of the 26-pair-cable terminates in a waterproof connector (U-185 hermaphrodite) with a waterproof cover. The cable is available in either 25-foot lengths or a 250-foot cable reel (RC-435/U), which weighs 68 lbs. The CX-4566/U is a 26-pair cable used to interconnect the components in a communications system. See Table E-2 for the technical characteristics of CX-4566 cable.

    d. CX-11230/G Coaxial Cable Assembly. CX-11230 cable consists of two twisted coaxial tubes jacketed in low-density polyethylene and is available in either 1/4-mile lengths or 100-foot lengths. The coaxial tubes are protected by mylar tape and medium density polyethylene jacket. The two tubes terminate in a universal connector at each end. A copper-clad, steel braid strength member is part of the cable assembly. The CX-11230/G cable can be installed on either the ground or in aerial installations and is a replacement for CX-4245/G cable assemblies. CX-11230 technical characteristics are found in Table E-3.

Table E-1. WF-16/U Characteristics

Characteristic	Value
DC resistance	30 ohms per 1,000 ft
Loop loss per mile @ 1 kHz	2.7 dB
Wire gauge	24 AWG
Mutual pair capacitance	Capacitance between a pair should not exceed 20 picofarads per foot.
Stray capacitance	Capacitance between one wire

Table E-2. CX-4566/U Characteristics

Characteristic	Value
DC resistance	30 ohms per 1,000 ft
Loop loss per mile @ 1 kHz	2.7 dB
Wire gauge	24 AWG
Mutual pair capacitance	Same as WF-16
Cable attenuation	Approximately 2.7 dB per mile @ 1 kHz

Table E-3. CX-11230 Characteristics

Characteristic	Value
DC resistance	22 ohms per 1,000 ft
Impedance	Maximum of 65 ohms, a minimum of 55 ohms in the range of 400 to 1,000 kHz.
Cross-talk isolation	Maximum of 60 ohms, a minimum of 55 ohms, in range 1,000 to 3,000 kHz.
Gage phase angle	At least 67 dB below signal level.
Attenuation per mile	4 dB maximum in the 1,000-3,000 range.
Connector	Rotation coupler UG-1879 terminates each end. The braid and outer contact of each coaxial cable is 7.5 ohms per 1,320 ft, 8.5 dB per mile at 2.304 kHz.

3. <u>Fiber Optic Cable and Systems</u>

   a. <u>Fiber Optic Cable Assembly, CX-13295/G</u>. The FOCA comes in 1-km and 300-m assemblies and has a capacity of two half-duplex channels (one XMIT and one RECV). Cable attenuation for the 300-m assembly at 25°C is 3 dB at a distance of 1,290 nm ± 20 nm (with two splices). For the 1-km assembly at 25°C, it is 3.75 dB at 1250 nm ± 20 nm (with two splices). The assemblies are terminated using hermaphroditic I connectors. An 8-km link weighs 880 pounds versus 3,000 pounds for an equivalent length of CX-11230 coax. An 8-km link is repeaterless and eliminates the requirement for coax modems.

   b. <u>Fiber Optic Modem-Receiver-Transmitter, MD-1272/G</u>. The FOM performs electro-optic conversion for full duplex transmission between the digital communications equipment within a shelter and an optical cable outside a shelter. The FOM typically mounts on the inside shelter wall. The electrical interface between the FOM and the shelter is made using a 55-pin, 16-gauge circular connector, MS-27468T17B35P type (MIL-C-38999). The FOM interfaces with the FOCA, CX-13295/G, via a dual channel, biconic fiber optic bulkhead connector that protrudes through a hole in the shelter SEP.

   c. <u>Applications</u>. The FOTS has the following five applications.

      (1) The FOTS interconnect with the following tactical communications assemblages:

            (a) AN/TRC-170, -173, -174, -175 radio terminals.

            (b) AN/TRC-138A radio repeater.

            (c) AN/TYQ-30, -31.

            (d) AN/TTC-39D.

            (e) AN/TSQ-146.

            (f) AN/TSQ-111.

            (g) TSSR.

            (h) AN/TSQ-165, TACC.

(2) The FOTS interconnects MSE and TRI-TAC systems, down-the-hill links, nodes, and dispersed command posts.

d. <u>Interfaces</u>. The FOM has the following equipment interfaces and electrical specifications.

(1) <u>Equipment Interfaces</u>

(a) <u>DGM Equipment</u>. TD-1235, TD-1236, TD-1237, MD-1026, and MD-1065.

(b) <u>Digital Orderwire Equipment</u>. C-10716/TRC and C-10717/TRC.

(2) <u>Electrical Interfaces</u>

(a) Balanced NRZ MIL-STD-188-114 data and clock signals range from 72 Kbps through 18.72 Mbps.

(b) 16 Kbps DVOW.

(c) 2 Kbps data orderwire.

(d) 16 Kbps maintenance orderwire.

(e) Conditioned Diphase, with digital orderwire (group modem) signals range from 72 Kbps to 4.608 Mbps.

e. <u>Optical Interface</u>

(1) <u>Central Wavelength</u>: 1290 nm (nominal).

(2) <u>Output Power</u>: -19.5 dBm minimum at 25° C.

(3) <u>Input Sensitivity</u>: -45.5 dBm minimum at 25° C.

(4) <u>Signal Format</u>: JTC3A Specification 9109C, "Technical Interface Specification, Joint Interoperability via Fiber Optic Cable."

4. <u>AN/GSC-54, Fiber Optic Cable System</u>. The FOCS provides a full-duplex transmission link between compatible items of TRI-TAC

equipment. The FOCS link can directly replace CX-1123OA/G coaxial cable, up to 6 kilometers in length, and operates at group data rates from 72 Kbps to 4.608 Mbps. FOCS equipment will accommodate CDϕ group signal (CDGS) levels from 0.1 to 3.0 V $_{p-p}$, combined voice/data orderwire signals between 0.25 and 1.0 volts $_{RMS}$, and AVOW signals from -6 to 5 dBm. The AN/GSC-54 provides optical transmit signal levels from -21.7 to -1.5 dBm. Optical receive signal levels are from -48 to -46.5 dB (or higher).

5.   AN/TAC-1, Fiber Optic Interface Unit. The AN/TAC-1 provides the capability to use fiber optic cable to connect tactical communications shelters. The unit is completely transparent to the connected equipment. Only JCSE and the Air Force are equipped with the FOIU.

   a. AN/TAC-1 Equipment Compatibility. The AN/TAC-1 can be used with any shelter or equipment with a TRI-TAC compatible conditioned diphase group interface. (See Table E-4.) The unit also provides the capability for two dedicated or switched telephone loops. The telephone loops are compatible with either analog or digital telephones. A nonsecure AVOW can be established between the AN/TAC-1 and any TRI-TAC shelter with an AVOW capability. This capability requires the use of the TS-3647 COU.

   b. AN/TAC-1 Interfaces. The AN/TAC-1 provides the following interfaces:

      (1) CDϕ (Group). This interface is used to connect the AN/TAC-1 to GMF shelters and to certain DGM equipment. Group rates can be from 72 Kbps to 4.608 Mbps. The AN/TAC-1 can support two groups with a combined rate less than or equal to 4.608 Mbps or one group at 4.096 or 4.608 Mbps. Connectivity to the shelter's DGM equipment is via coaxial cable. The cable may be a maximum of 1/4 mile in length.

      (2) Conditioned Diphase Loop. This interface is used to connect the AN/TAC-1 to TRI-TAC digital telephones. It is also compatible with digital loops provided by TRI-TAC circuit switches. The loop rate can be either 16 or 32 Kbps. The AN/TAC-1 can support a maximum of two loops.

Table E-4. AN/TAC-1 Equipment Compatibility, Interface, and
Connectivity

Equipment	Interface Type	Maximum Capacity	Data Rate (Kbps)	Electrical Interface	Connecting Media
AN/TSQ-111	Group	2 1/	72-4608	CDφ	Coax Media
AN/TTC-39 Series	Group	2 1/	72-4508	CDφ	Coax Media
AN/TTC-42	Group	2 1/	72-4608	CDφ	Coax Media
SB-3865	Group	2 1/	72-576	CDφ	Coax Media
AN/TSC-93B/94A	Group	1	72-4608	CDφ	Coax Media
AN/TSC-85B/100A	Group	2 1/	72-4608	CDφ	Coax Media
AN/TRC-170	Group	2 1/	128-4608	CDφ	Coax Media
AN/TSQ-146	Group	2 1/	72-4608	CDφ	Coax Media
TD-1233	Group	1	72-144	CDφ	Coax Media
TD-1234	Group	1	72-576	CDφ	Coax Media
MD-1026	Group	2 1/	72-4608	CDφ	Coax Media
RT-1462	Group 2/	1	6.144 Mbps	NRZ	Coax Media
TA-954, KY-68	Loop	2	16 or 32	CDφ	Field Wire
TA-341, TA-838	Loop	2	CVSD @ 32 Kbps	Audio	Field Wire

1/ If the AN/TAC-1 is required to support two groups, the individual group
     rates cannot exceed 2,304 Kbps.
2/ This is the multiplexed output of the AN/TAC-1 to the TSSR.

     (3) Analog Loop. This interface is used to connect the AN/TAC-1
to four-wire analog telephones. The AN/TAC-1 uses CVSD to convert the
analog input from the telephone to a 32-Kbps CDφ signal. A maximum of
two analog telephones can be connected to the AN/TAC-1. Connectivity
to the telephone instrument is via telephone cable up to 2 miles in
length.

(4) <u>RT-1462 and AN/GRC-239/TRC-170 TSSR Interface</u>. This interface allows the AN/TAC-1 to be used as a multiplexer to increase the capacity of the TSSR from one group to the two-group/two-telephone capacity of the AN/TAC-1. The interface is NRZ and the data rate is 6.144 Mbps. Connectivity to the TSSR is via coaxial cable up to a maximum of 400 feet in length.

6. <u>RT-1462/TRC-170 Tropo-Satellite Support Radio</u>. The RT-1462/TRC-170 TSSR is an LOS, SHF radio that can be used in conjunction with the CX-11230 coaxial cable or the fiber optic cable used with the AN/TAC-1. Only the JCSE and the Air Force are equipped with the TSSR. There are two versions of the TSSR, the original RT-1462 and the follow-on AN/GRC-239 (see paragraph 7). It is normally used for remoting the AN/TRC-170 tropo radio or the GMF satellite terminals. The radio transmitter, receiver, and orderwire have separate chassis. Table E-5 is a listing of RT-1462 characteristics. The receiver and transmitter are modular in design and have remotable RF modules that are not part of the main chassis. If the antenna is to be mast mounted, the transmitter and receiver RF modules are mounted with the antenna at a distance of up to 400 ft. from the transmitter and receiver. Figure E-1 shows the TSSR configuration when the RF modules are remoted. If the antenna is located at the transmitter/receiver location, the RF modules are housed in the transmitter and receiver enclosures.

a. <u>Transmitter</u>. The transmitter has six modules: the control/monitor, baseband, AFC, synthesizer, RF, and power supply modules. Data from an external modem pass through the control monitor attenuator to the baseband module. The attenuator at the control monitor can be adjusted for signal levels from an MD-1026 group modem or the AN/TAC-1. The baseband module filters the baseband signal for modulating the voltage-controlled oscillator (VCO) in the RF module. The baseband module sums the baseband signal with the orderwire subchannel. The composite signal is sent over a remote cable and modulates the VCO in the RF module. The FM output of the VCO has a center frequency near 2 GHz. The RF module translates this to the selected carrier frequency in the SHF band and sends it to the antenna. The FM signal from the VCO is also mixed with a reference signal from the synthesizer module.

Table E-5. RT-1462/TRC-170 TSSR Characteristics

| Characteristic	Value
Frequency Range (GHz)	14.4-15.25
Transmit Power	100 mW
Modulation	FM
Deviation	8 MHz $_{P-P}$
Transmitter	
Frequency Stability	0.003%
Frequency Control Ref	Digital Synthesizer
Type of Tuning	Direct Reading Dial
Receiver	
Noise Figure (dB)	12
IF Frequency (MHz)	70
IF Bandwidth (MHz)	30
Preselector	Continuous Tuning with Direct Frequency Reading
Threshold (dBm)	-78
RF Input Level (dBm)	-20, maximum
	-30, typical
Frequency Control	Tracking AFC
Type of Tuning	Direct Reading Dial
Antenna Gain (dBi)	
Two-Foot Antenna	37
Four-Foot Antenna	43
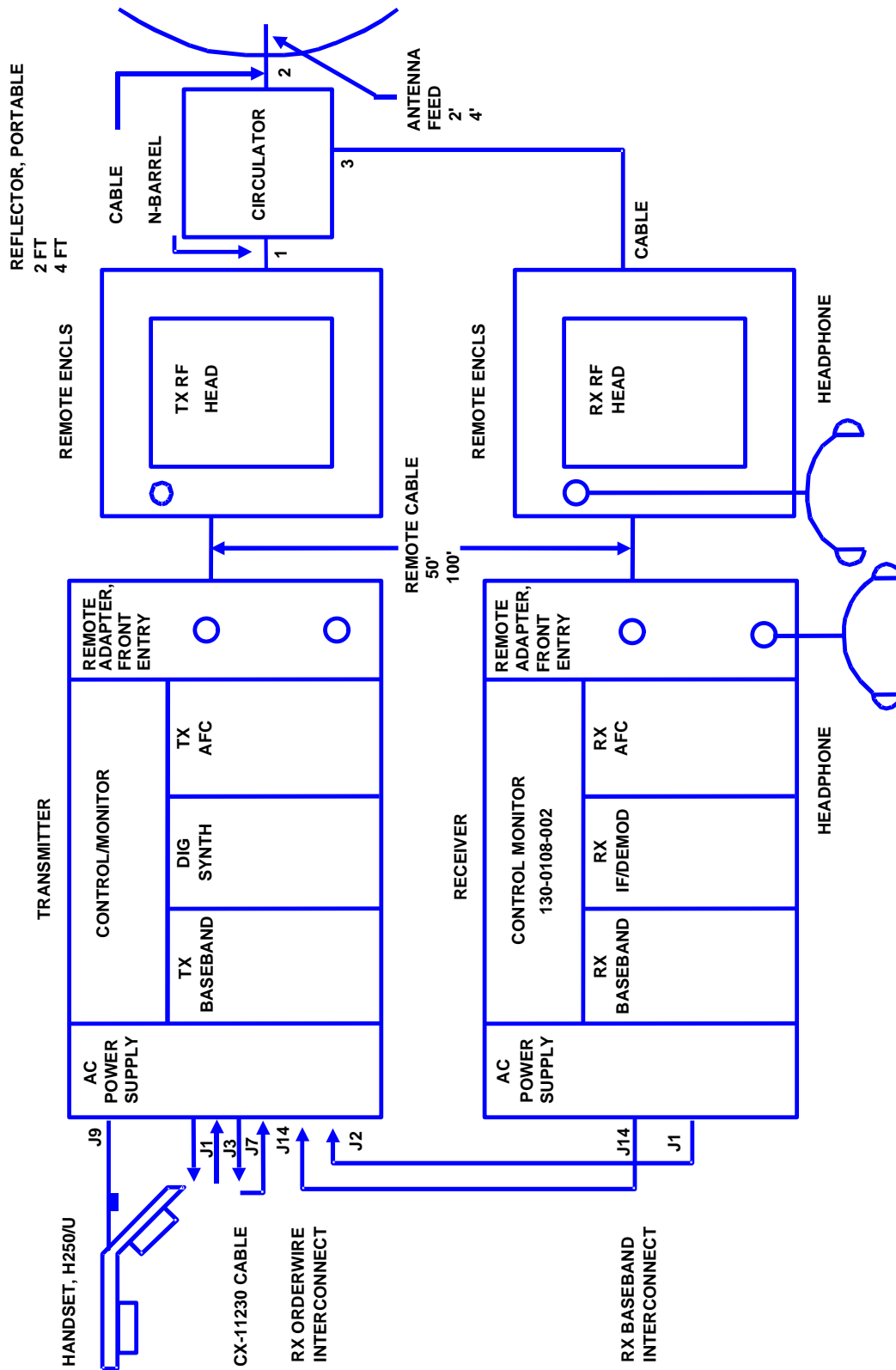
Figure E-1. TSSR Configuration with Transmitter and Receiver RF Modules Remoted

The output is the FM detected by a discriminator in the AFC module. Voltage from the discriminator is fed back to control the output carrier drifts. Figure E-2 shows the transmitter block diagram.

b. Receiver. The receiver modules are the control/monitor, baseband, IF, AFC, RF, and power supply. The RF module filters the signal from the antenna. The filter center frequency is selectable. The filter keeps the transmitted RF signal from coupling back into the receiver. The received signal is mixed with a local oscillator whose frequency is controlled by a feedback signal from the receiver AFC module. The VCO output compensates for frequency drift in the incoming signal and keeps the signal in the IF module at the center frequency. At the demodulator, the 8.5-MHZ orderwire subcarrier channel is demodulated and sent over the orderwire. The digital baseband signal is filtered and passed though the control monitor for transmission to the external modem. Figure E-3 shows the receiver block diagram.

c. Antenna System. The TCM-608B TSSR is delivered with 2-foot and 4-foot dish antennas. The antenna as supplied is tripod mounted. Considerations for selecting a tripod or a mount depend on the physical profile of the SHF LOS link. A mast mount may be necessary to set up the LOS link. The TCM-608B TSSR radio is capable of establishing a 26-km link using a 4-foot antenna. Generally, the 4-foot antenna would be used, even with tripod mounts, unless extreme wind or ice loading necessitates the use of the 2-foot antenna. LOS links less than 8 km can use the 2-foot antenna.

d. Interfaces. The TSSR can support the interfaces discussed in subparagraphs d(1) through d(3) below.

(1) TRI-TAC CDφ Interface. The TSSR interfaces directly with group modems that output a TRI-TAC CDφ signal. Data rates may be 72-4,608 Kbps. Typical modems are as follows:

(a) MD-1026 Group Modem with a CDφ modem module.

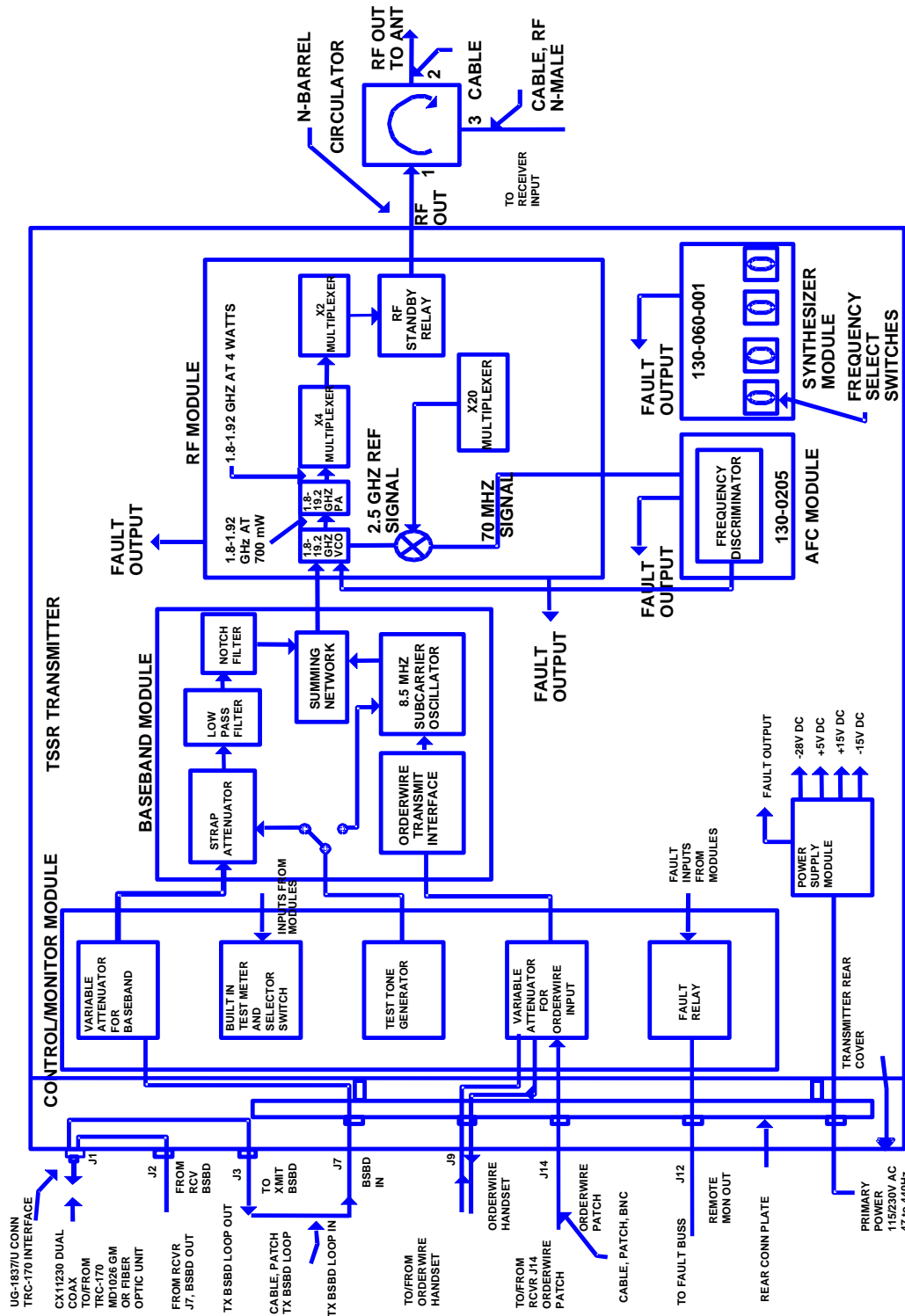(b) TD-1337 TSSP conditioned CDφ modem.

(c) AN/TCC-39 series CDφ group.
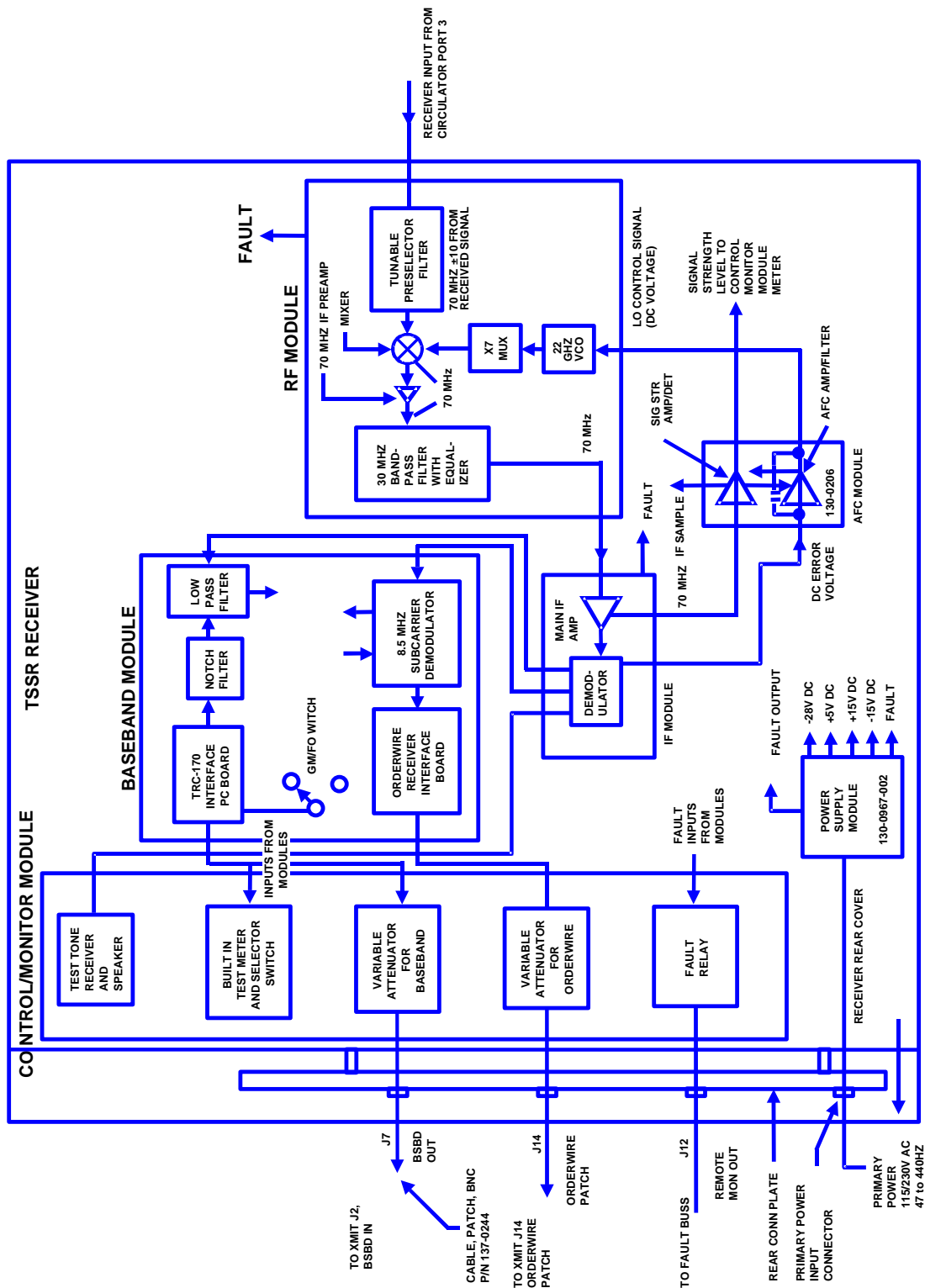
Figure E-2. TSSR Transmitter Block Diagram

Enclosure E

Figure E-3. TSSR Receiver Block Diagram

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(d) AN/TTC-42 CDϕ group modem.

(e) AN/TSQ-111 CNCE CDϕ group.

(f) TD-1233 RLGM.

(g) TD-1234 RMC.

(h) The TRI-TAC CDϕ interface with the TSSR is via CX-11230 cable. The cable may be a maximum of 1 mile. At the transmitter, the baseband attenuator switch and the baseband strap attenuator should be adjusted so that carrier deviation is in the "blue" region on the control monitor meter. At the receiver, the group modem/fiber optic (GM/FO) switch should be set to "GM." Figure E-4 is a typical configuration.

(2) <u>AN/TAC-1 Interface</u>. The TSSR also interfaces directly with an AN/TAC-1 via CX-11230 cable at 6,144 Kbps. Maximum length is 400 ft. At the transmitter, the baseband attenuator switch should be set as above. At the receiver the GM/FO switch should be set at "FO." Figure E-5 depicts a typical configuration.

(3) <u>ATACS Dipulse Interface</u>. The TSSR interfaces directly with group modems that output an ATACS dipulse signal. The line rate in this configuration is a constant 2,304 Kbps. Typical modems are as follows:

(a) MD-1026 Group Modem with a dipulse modem module.

(b) AN/TTC-39 dipulse group modem.

(c) AN/TSQ-111 dipulse group modem. The dipulse interface with the TSSR is via CX-11230 cable. The cable may be a maximum length of 1 mile. At the transmitter, the baseband attenuator switch and the baseband strap attenuator should be set as above. At the receiver, the GM/FO switch should be set to "GM."
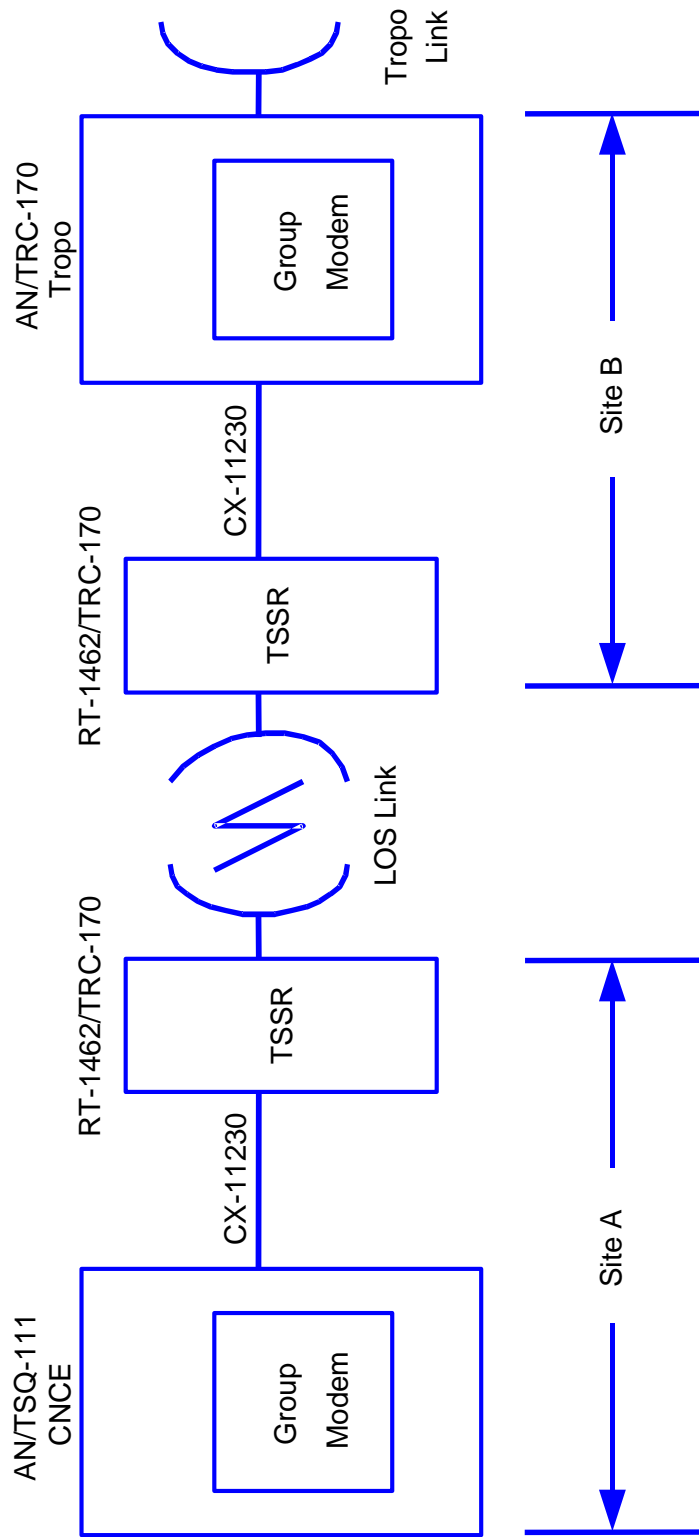
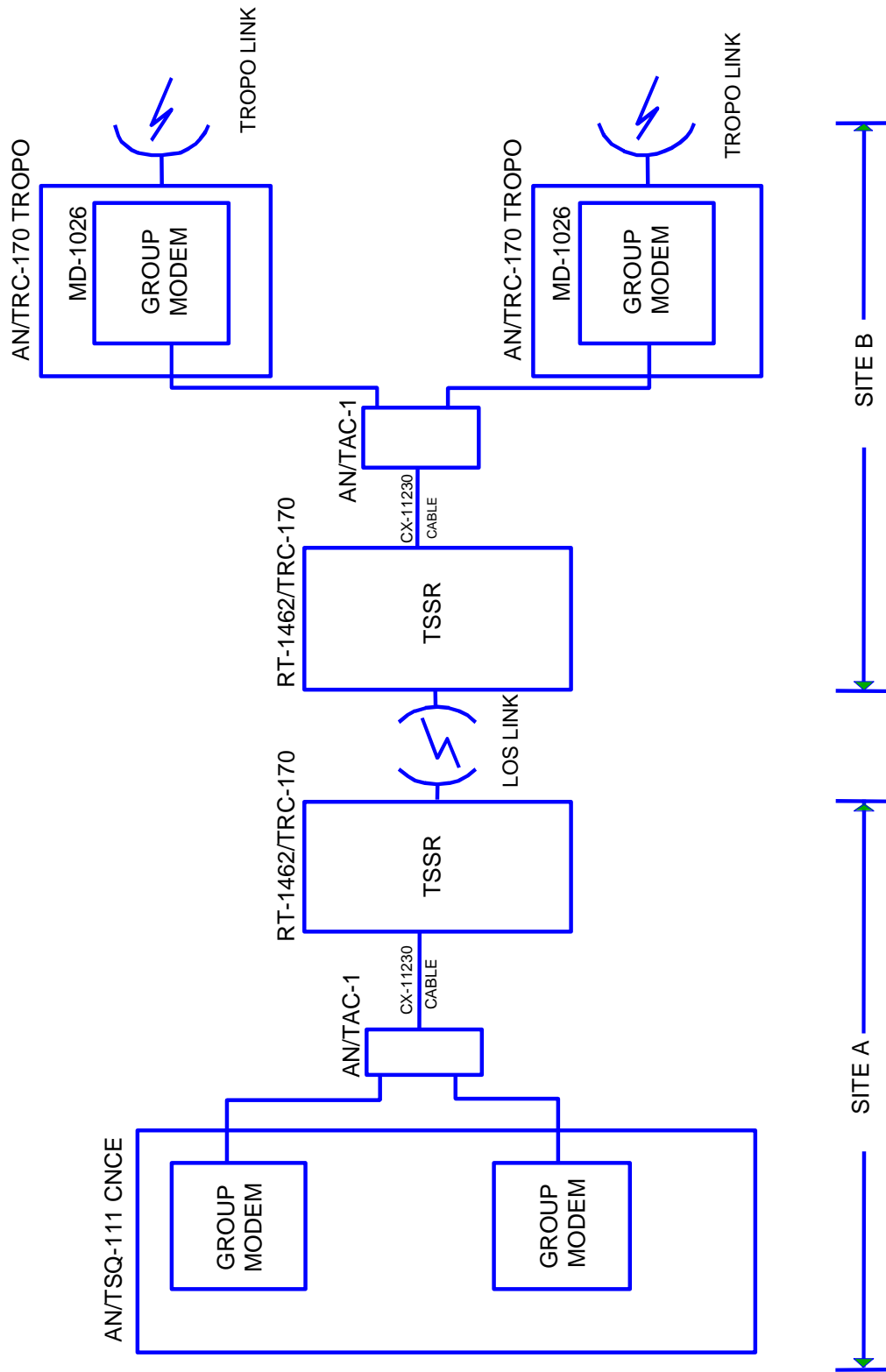Figure E-4. Typical TSSR Conditioned Diphase Configuration

Enclosure E

Figure E-5. TSSR to AN/TAC-1 Configuration

Enclosure E

e. Orderwire. The TSSR has an integral orderwire system to permit operator voice communications between the two ends of a radio link during link alignment and radio operation. The operator at the opposite end of the link is alerted by a signal tone. Orderwire voice communications do not interfere with mission traffic. This orderwire cannot be interconnected with any other orderwire. The TSSR will assist without degradation to the DVOW, DOW, and AVOW orderwires. There is, however, no access to these orderwires at the TSSR.

f. Frequency Assignment. The operating frequencies for a collocated transmitter and receiver should be at least 200 MHz apart for optimum performance. Operating frequencies as close as 100 MHz can be used if care is taken during the transmitter and receiver tuning process.

g. Crew Assignment Sheet. A crew assignment sheet and a set of instructions for completing the sheet are found in Appendix D to Enclosure A.

7. AN/GRC-239, TSSR. The AN/GRC-239 is a complete light, tactical weather-proof, full-duplex and LOS radio system that can set up to interconnect TRI-TAC and GMF satellite and remote terminals. The TSSR link can be interfaced with or substituted for cable links employing modems such as the MD-1026 or the AN/TAC-1. The AN/GRC-239 is electronically interoperable with the AN/TRC-170 TSSR.

a. The AN/GRC-239 radio system (transceiver) consists of two assemblies RF and baseband. The RF assembly and 1-foot antenna can be mounted on a 50-foot lightweight mast. The antenna and RF section can be erected on any one of the following three mounts.

(1) A 50-foot, lightweight erectable mast system.

(2) A field tripod.

(3) A pipe mount system for attaching to an existing tower.

b. The transceiver consists of two assemblies, the RF and baseband, which are either joined as a single unit or separated by up to 150 feet by cable. The RF assembly contains all of the RF circuitry of the transmitter and the RF circuitry of the receiver through the second IF amplifier. The baseband assembly contains the transmitter baseband circuits and the receiver baseband circuits.

c. The antenna system contains a 1-foot diameter antenna that is mounted on the 50-foot mast with the RF assembly. When additional performance is required, a 2-foot diameter antenna can be mounted on a tripod with the RF and baseband assemblies. Both antennas can be set by the operator to either horizontal or vertical polarization. With the 1-foot antenna, the range is 10 miles; it is 20 miles using the 2-foot antenna.

d. Technical Characteristics. See Table E-6.

Table E-6. AN/GRC-239 TSSR Technical Characteristics

Characteristics	Value
System Performance	
Frequency Range	14.4-15.25 GHz, in 1 MHz steps
Modulation	FM, ±4 MHz deviation
Input Data	0.72-4.608 Mbps CDφ from the MD-1026 or pseudo-NRZ @ 6.144 Mbps from the AN/TAC-1 Optical Set. (Also capable of interconnecting up to four T1 (1.544 Mbps) or E1 (2.048 Mbps) signals via TSSR DR-MUX.)
TSSR Orderwire 1/	8.5 MHz subcarrier
Signal-to-Noise Ratio	50 dB
Residual Bit Error Rate	1×10^{-10} when RCL is -40 dBm and traffic is 4.608 Mbps CDφ or 6.144 Mbps pseudo-NRZ.
Duplex Spacing	200 MHz or greater
System Gain	101 dB at data BER 1×10^{-6}
Transmitter Specifications	
Baseband Level	1 V_{p-p} with the input attenuator set to 0 dB. Full deviation ±4 MHz. Level adjustable to -30 dB in 1 dB steps.
Frequency Accuracy	Frequency selected to within 50×10^{-6} (50 ppm)
Frequency Stability	Long term: 0.003%

Table E-6. (Cont'd)

Characteristics	Value
Occupied Bandwidth	<15 MHz at 3 dB
Output Power	26.5 dBm (450 mv)
Receiver Specifications	
Noise Figure	7 dB
IF Bandwidth	20 MHz
Frequency Stability	Long term: 0.003%
Output Level	3 V_{p-p}
Antenna Subsystem	
Antenna Size	1 foot 2 foot
Gain	1 foot: 31 dBi 2 foot: 37 dBi
Beamwidth	1 foot: 6° 2 foot: 3°
Side Lobe Suppression	-20 dB
Polarization	Selectable horizontal and vertical
Polarization Isolation	-20 dB, minimum

1/ Also system orderwire--analog @ 300 Hz - 3.4 kHz or digital @ 16 or 32 Kbps.

ENCLOSURE F

INTRODUCTION TO MULTICHANNEL LINE-OF-SIGHT SYSTEMS

1. <u>Introduction</u>. LOS radio assemblages, addressed in this enclosure is normally employed in situations where medium and large digital transmission groups must be propagated over distances under 50 km (30 miles). These distances can be extended by the use of radio repeaters. Low- and high- capacity cable systems may also be supported by equipment contained in certain of the LOS radio assemblages. Appendix A through D, respectively, present the functional descriptions, characteristics, capabilities, and major components of the AN/TRC-138A, AN/TRC-138B, AN/TRC-173, AN/TRC-173B, AN/TRC-174, AN/TRC-174B, AN/TRC-175, and AN/TRC-175B LOS radio assemblages that are employed by the Army at EAC. These terminals were developed and procured by the Army under the TRI-TAC program. Figure F-1 depicts a representative Army EAC LOS system between the JTF and ARFOR. Also shown is a representative configuration of the LOS systems at the ARFOR node. This figure is used as the basis for the discussion in paragraph 2. Paragraphs 3 and 4 identify LOS assemblages employed by the Marine Corps and the Army at ECB. These assemblages are discussed in greater detail in Appendix E and F, respectively.

2. <u>EAC LOS Network Configurations</u>. Army assemblages that support the LOS network are employed in three separate network configurations. Each network configuration is addressed below.

    a. <u>Short-Range Wideband Radio System Configuration</u>. The AN/TRC-175 Radio Terminal Set and the AN/TRC-138A Radio Repeater Set interface with each other to provide a wideband, up to 18.72 Mbps, TOH/BOH SRWBR link. The TD-1237 MGM within the AN/TRC-175 combines up to 12 individual digital groups into a mastergroup for transmission to the TOH. At the TOH, the transmission group is demultiplexed and each of the individual groups is input to one or both of the remaining AN/GRC-222 radios within the AN/TRC-138A, or via GM forwarded to the appropriate LOS radio repeater assemblage. Individual groups can also be inputs to tropospheric scatter radio assemblages, satellite assemblages, or to DGM standalone equipment such as RMCs.
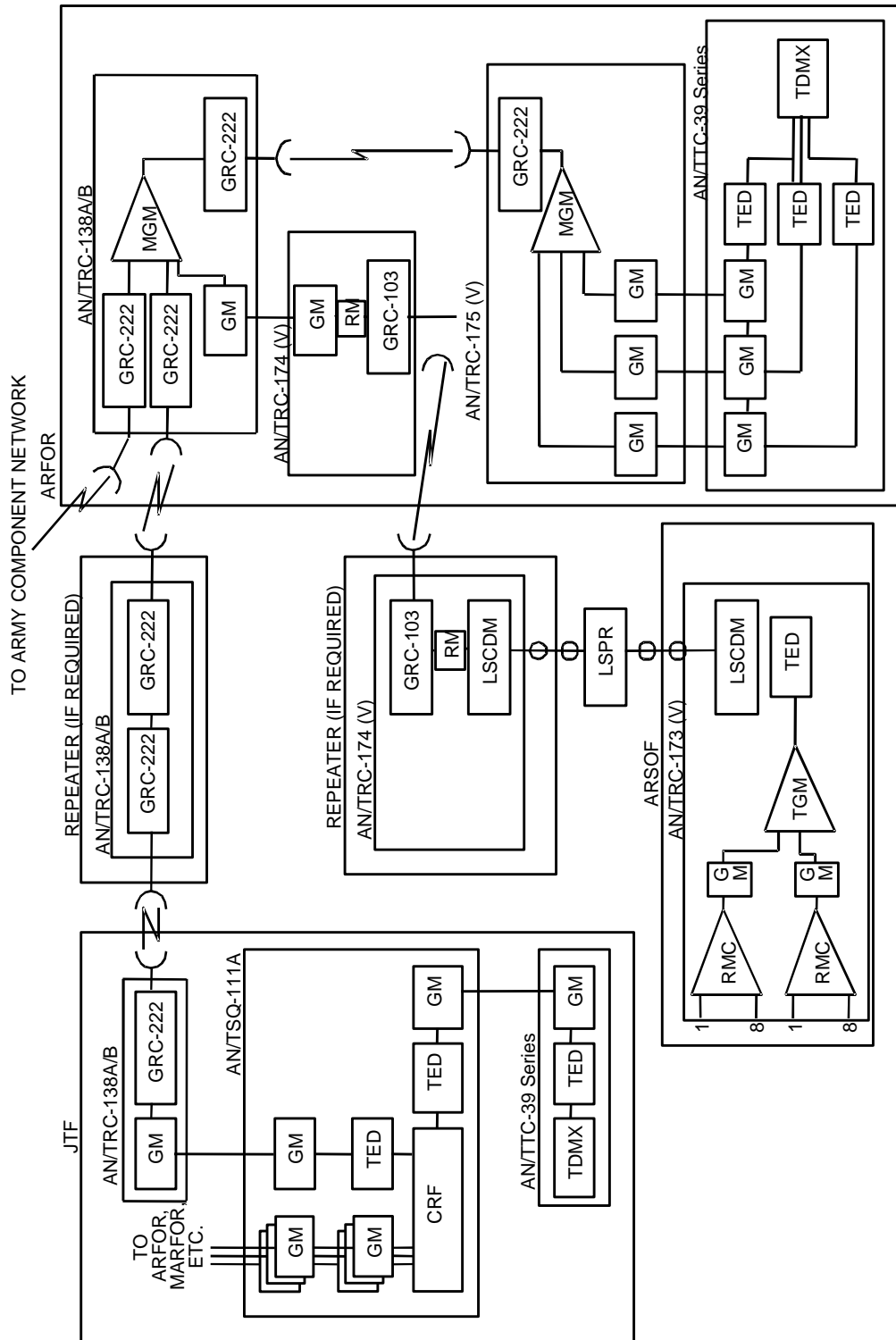
Figure F-1. Army EAC LOS Systems

The processor is reserved for groups arriving at the TOH that are destined for transmission to the BOH. Neither the AN/TRC-138A nor the AN/TRC-175 contain KG-81 TEDs. Groups to be transmitted must be encrypted by other facilities such as the AN/TSQ-111 or AN/TTC-39 series CS.

  b. Radio Repeater System Configuration. AN/TRC-138A and the AN/TRC-174 Radio Repeater make up the second LOS system configuration. Transmission groups that have been demultiplexed from the mastergroup by the MGM within the AN/TRC-138A are presented to either the AN/GRC-222 radios within the same AN/TRC-138A or within another AN/TRC-138A located at the TOH. The groups transmitted over AN/GRC-222 radio links for this application may be up to 4,608 Kbps (144 channels at the 32-Kbps VDR). Other individual groups may be presented to AN/GRC-103(V)4 radios within AN/TRC-174 repeater assemblages also located at the TOH. The AN/GRC-103 can accommodate transmission groups of up to 1,152 Kbps (36 channels at the 32-Kbps VDR). These individual transmission groups may then be transmitted through other AN/TRC-138A assemblages or other AN/TRC-174 assemblages respectively. The AN/TRC-174 assemblage does not contain any TEDs.

  c. Radio Terminal System Configuration. The third LOS configuration is supported by the AN/TRC-173 Radio Terminal Set. This assemblage provides the capability to multiplex individual users into loop groups with RMCs and to combine two or more of these groups into a single group with the TGM and to transmit this group to either another AN/TRC-173 or to an AN/TRC-174 assemblage. The AN/TRC-173 can support up to two radio systems, each at data rates of up to 1,152 Kbps, and two cable systems utilizing the LSCDMs at a data rate of up to 2,048 Kbps and two cable systems utilizing the LSCDMs at a data rate of up to 2,048 Kbps if fully equipped. The shelter is wired to accommodate a second LSCDM, but only one is provided. The AN/TRC-173 is the only LOS assemblage that contains TEDs; it has two. The TEDs and RMCs within the AN/TRC-173 allow for its use as a terminal facility. The AN/TRC-173 can also be employed at the TOH or as a repeater, but neither employment is common.

3. Marine Corps LOS Employment. The Marine Corps utilizes the AN/MRC-142 to interconnect ULCSs. Figure F-2 indicates a representative AN/MRC-142 employment. (See Appendix E.)

4. <u>Army ECB LOS Employment</u>. At ECB, the Army uses the AN/TRC-190(V) assemblages and AN/GRC-224 to support LOS operations. These radios are discussed in Appendix F. Figure F-3 is a generic representation of the MSE LOS radio employment.

WEST

SB-3865
OR
AN/TTC-42

MODEM

CDA **2/**

AN/MRC-142

3/

AN/MRC-142

CDA **2/**

EAST

SB-3865
OR
AN/TTC-42

MODEM

KY-57
VINSON **2/**

KY-57
VINSON **2/**

TED **1/**

TED **1/**

MUX

MUX

MATRIX

MATRIX

1/ **The TEDs can be located:**
  a. **As depicted.**
  b. **One TED with the West (or East) switch and one with the East (or West) CDA/radio set.**
  c. **One TED with each CDA/radio set.**

2/ **The CDA and KY-57 are components of the AN/MRC-142.**

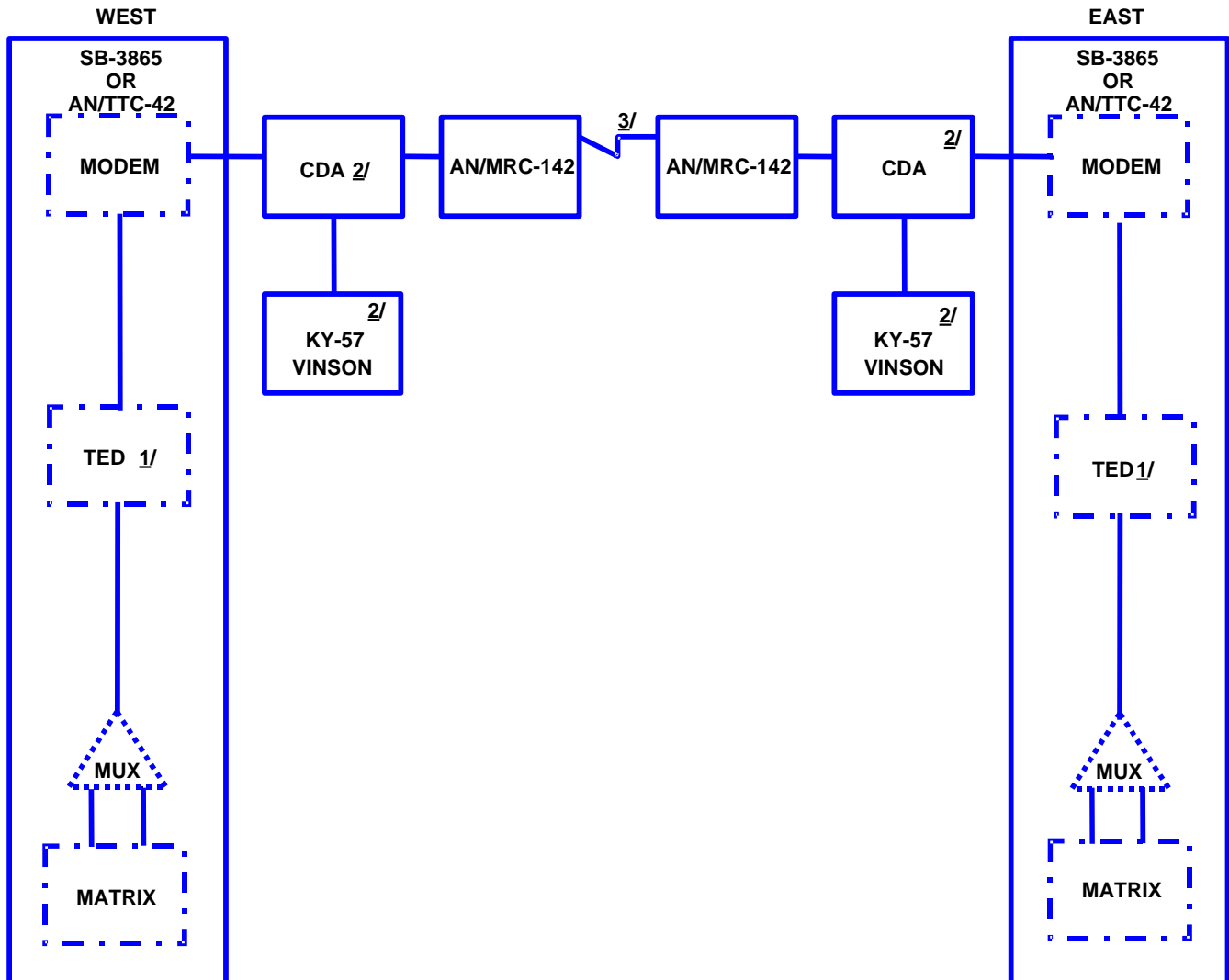**3/** **The AN/MRC-142 can provide two simultaneous links.**

Figure F-2. Representative AN/MRC-142 System Configuration, ULCS to ULCS
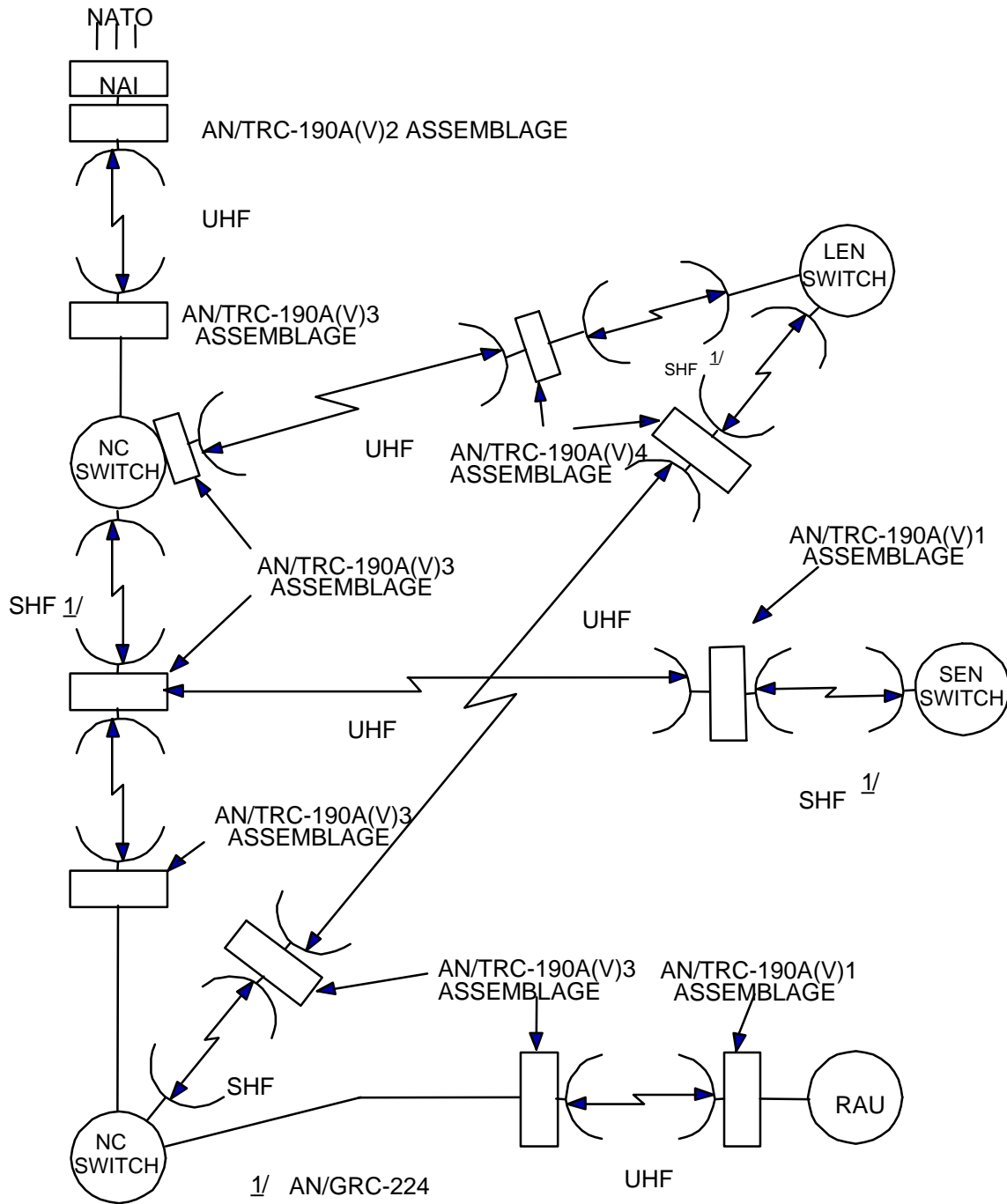Connection

Figure F-3. Employment of MSE LOS Radio Terminal Assemblages

APPENDIX A TO ENCLOSURE F

AN/TRC-138A/B RADIO REPEATER SET

1. <u>AN/TRC-138A Functional Description</u>. The AN/TRC-138A is housed in Shelter Facility S-667/TRC-138A and can function as a radio or cable terminal for the link from the radio park TOH to the AN/TRC-175 at the BOH. When used as one end of the TOH/BOH link, an integral second-level multiplexer combines up to 12 groups into a mastergroup and vice versa. The mastergroup is then connected to either a radio or a cable driver, as appropriate. The assemblage may also function as the terminus for up to two intranodal radio links or as a repeater for such links. When used in this manner, a single group is accommodated by radio or a combination of radio and group modem. Note that there is no integral capability for bulk encryption and groups requiring encryption must be encrypted by other equipment prior to traversing this assemblage. The assemblage accommodates voice and data orderwires and has provisions for recovering and distributing timing. The AN/TRC-138A is typically employed at Army node radio parks or as a repeater. The AN/TRC-138B is a downsized variant housed in an S-749 shelter. A typical employment is shown in Figure F-1.

2. <u>AN/TRC-138A/B Technical Description</u>. Figure F-A-1 is a functional block diagram of the AN/TRC-138A. The assemblage is equipped with three AN/GRC-222 radio sets. (See Table F-A-1.) Each radio set has the capability to transmit and receive a mastergroup. Only one of the three radios at any given time can operate at the maximum bit rate (9.36 or 18.72 Mbps) because there is only one integral MGM. The other two radios may be used for intranodal links. The radios operate in the SHF frequency range. Active Army Signal units are being equipped with the AB-373 DGM Antenna Mast Program (DAMP). A limited quantity of AB-309 masts will be retained.

    a. <u>AN/GRC-222 Radio Technical Characteristics</u>. See Table F-A-2.

    b. <u>Mastergroup Cable Interface</u>. The mastergroup cable interface is provided by the HSCDM. (See Enclosure B.) The HSCDM can transmit and receive a mastergroup over an unrepeatered or repeatered cable link. Table F-A-3 lists the HSCDM's principal technical characteristics.
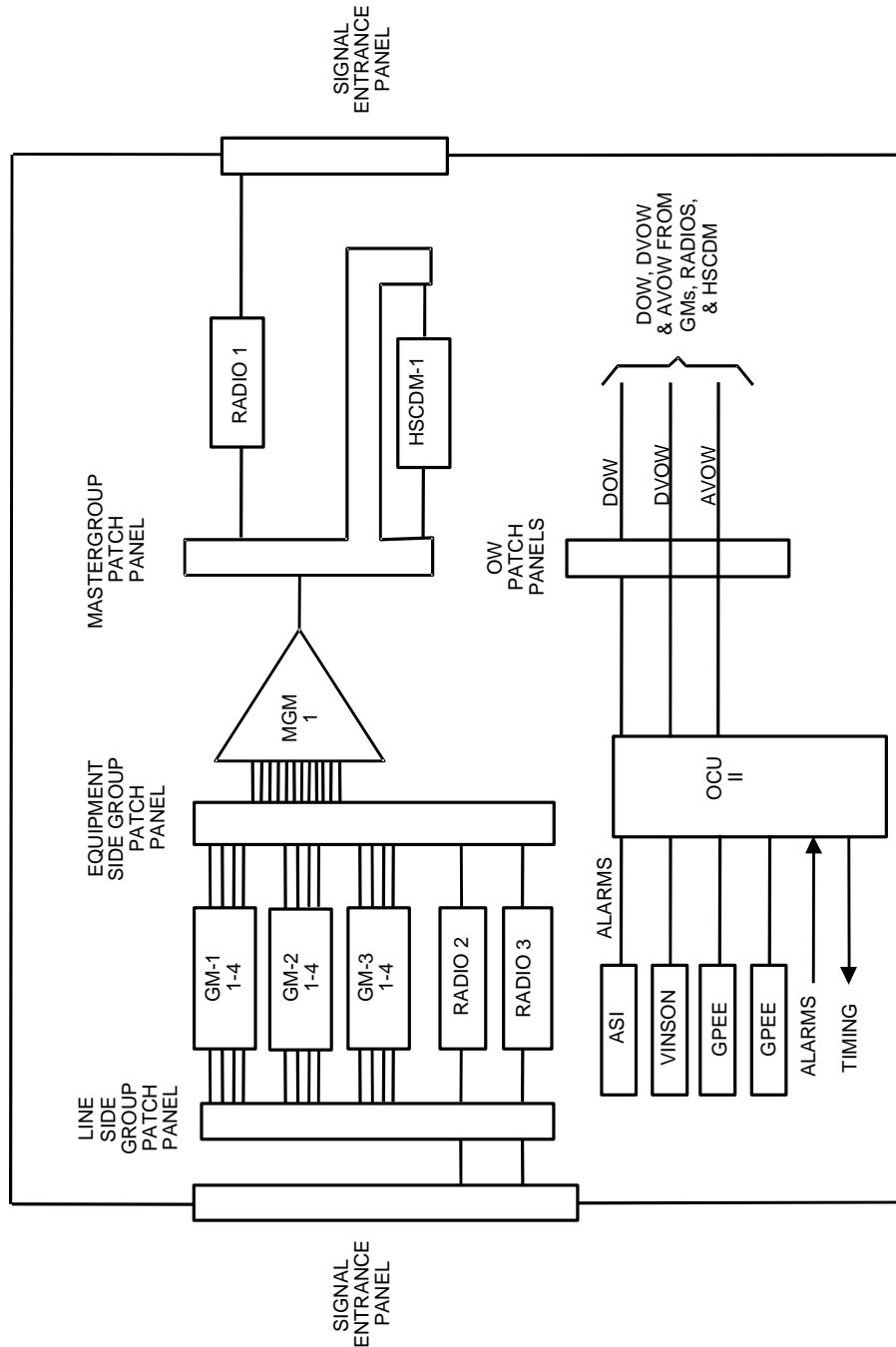
Figure F-A-1. AN/TRC-138A Functional Block Diagram

Appendix A
Enclosure F

Table F-A-1. AN/TRC-138A Major Equipment Items

Equipment Item	Quantity
AB-1373, Antenna Mast	3
AB-1309, Antenna Mast	1
AN/GRC-222, Radio Set	3
AS-1425, Antenna	3
AS-1729, Antenna	1
C-10717, OCU-2	1
MD-1026, GM	3
MD-1024, HSCDM	1
RT-524	1
TD-1237	1
KG-84(V)	2
KY-57	1
KY-68	1

Table F-A-2. AN/GRC-222 Technical Characteristics

Characteristic	Value
Frequency	4.4-5.0 GHz (in 100 kHz steps)
Range	Up to 8 km @ 9.36/18.72 Mbps Up to 40 @ at 1,024-4,608 Kbps
Data Rates	1,024-4,608 Kbps and 9.36/18.72 Mbps
Modulation	8 PSK- 9.36/18.72 Mbps 4 PSK- 1,024-4,608 Kbps
Threshold (10^{-5} BER)	-88 dBm @ 4,608 Kbps or less -75 dBm @ 9.36 Mbps -66 dBm @ 18.72 Mbps
RF Output	+ 29 dBm minimum @ 8 PSK + 34 dBm minimum @ 4 PSK

Table F-A-3. MD-1024 Technical Characteristics

Characteristic	Value

Range
  Unrepeatered
  With repeaters
	Up to 0.4 km
	Up to 8 km with repeaters no further than 0.4 km apart.

Data Rates
  Equipment Side
  Line (cable) side
	4.096, 4.608, 9.36, 18.72 Mbps NRZ).
	19.2 Mbps (CDϕ).

    c Group Modem Cable Interface. The cable interface for groups operating at the lower rates is provided by the GM. The GM can accommodate ATACS as well as TRI-TAC groups by selecting the proper mode. Interfaces for the AVOWs, DVOWs, and DOW are provided by the OCU-II and appropriate DGM components. The GM converts up to four CDϕ, bipolar, or dipulse cable inputs to an NRZ data and timing signal and vice versa. It accommodates an AVOW or, for diphase signals at data rates over 256 Kbps, a DVOW and DOW. The principal technical characteristics are found in Table F-A-4.

Table F-A-4. MD-1026 Characteristics

Characteristic	Value

Range
  72-576 Kbps
  1,024-2,304 Kbps
  4,096-4,608 Kbps
  4.9152 Kbps
	3.2 km
	1.6 km
	0.8 km
	0.8 km, 8 km with repeaters every 0.8 km

Data Rates
  Equipment Side
  Line Side
	72-4.9152 Mbps (NRZ)
	72-4,608 Kbps (CDϕ)
	2,304 Kbps (Dipulse) 1/
	4.9152 Mbps (Bipolar) 2/

Range- 2,304 Kbps dipulse	1.6 km, 32 km with repeaters

1/ Power to drive dipulse cable systems is provided by the TD-754 and is looped back by the CH OW in the GM.
2/ Power to drive bipolar cable systems is provided by the TD-976 and is looped back by the GM.

3. <u>AN/TRC-138A/B Employment and Configuration</u>. The AN/TRC-138A/B is normally employed at Army major node radio parks TOH to the switching node BOH. It can also be used in the radio repeater, terminal, SRWBR applications. Figure F-1 illustrates how the radio repeater set may be employed in a joint network. The figure shows how the assemblage is employed to provide LOS connectivity between the JTF and ARFOR as the TOH terminal at the ARFOR node. Figure F-A-2 shows the AN/TRC-138A configuration at the TOH. Blank crew assignment sheets and the instructions for their use are found in Appendix D to Enclosure A.
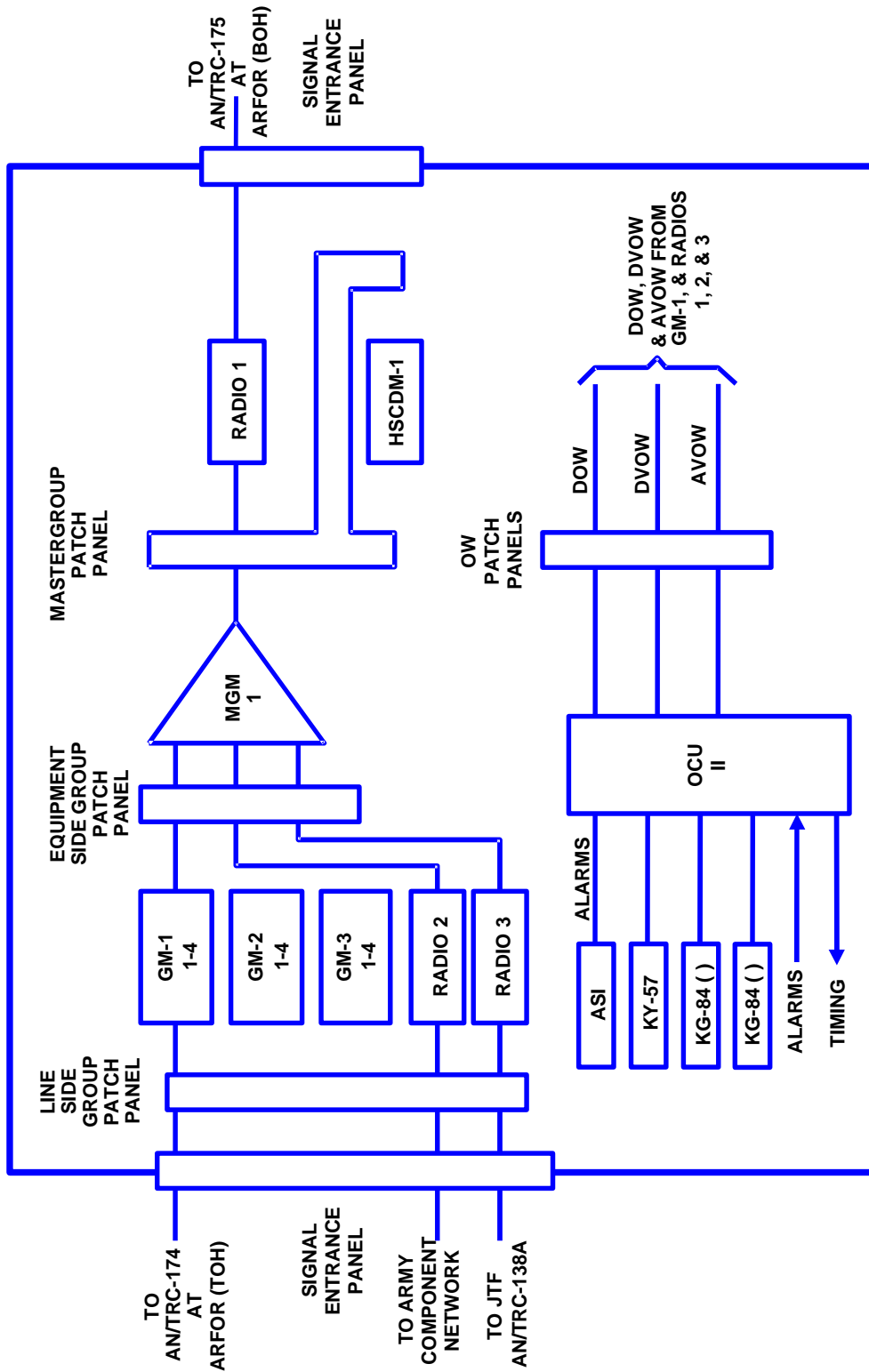
Figure F-A-2. AN/TRC-138A Example Configuration (TOH)

Appendix A
Enclosure F

APPENDIX B TO ENCLOSURE F

AN/TRC-173 RADIO TERMINAL SET

1. <u>AN/TRC-173 Functional Description</u>. The AN/TRC-173 can function as a radio or cable terminal set. Externally located, first-level multiplexers are used to form time division multiplexed groups of digital or analog four-wire subscriber terminals. These groups, as well as other groups that may be formed by digital switches, for example, are then further multiplexed into supergroups by an internal second-level multiplexer. The terminal will accommodate two of these supergroups over integral independent radio sets when employed as a radio terminal. As a cable terminal it will accommodate two supergroups over repeatered or nonrepeatered cable systems, if fully equipped. It will also operate as a split terminal; that is, one supergroup over a radio system and another over a cable system. The assemblage contains integral COMSEC that may be used to bulk encrypt/decrypt the supergroups. The radio terminal set also accommodates analog voice and digital encrypted voice and data orderwires and has provisions to recover and distribute timing. The AN/TRC-173 is typically employed at Army extension nodes and can be employed as shown in Enclosure F, Figure F-1.

2. <u>AN/TRC-173 Technical Description</u>. The radio interface is provided by two radio sets, AN/GRC-103(V)4. Each radio has the capability to transmit and receive a supergroup of up to 36 channels. The radios operate in the UHF Band IV frequency range and have a planning range of approximately 48 km (30 miles). Active Army units are being equipped with the AB-1373 DAMP. A limited number of AB-1309s are being retained. The cable interface is provided through a LSCDM. The subscriber terminal interface is provided through an RLGM and/or RMC. Digital four-wire loops terminate into the multiplexer loop modem printed card assemblies (PCA), while analog four-wire loops terminate into the Analog Applique PCA. Each PCA terminates two loops. The multiplexed groups terminate into the AN/TRC-173 Group Modems or into the RLGM/CD. Four RMCs (no RLGMs) are issued as part of the AN/TRC-173. Additional multiplexers from other resources have to be provided for the assemblage to be used to its full potential. The interfaces for the AVOW, DVOW, and the DOW are provided by the OCU-I and appropriate DGM components. Figure F-B-1 is a functional block diagram of the AN/TRC-173. Table F-B-1 is a listing of major components.
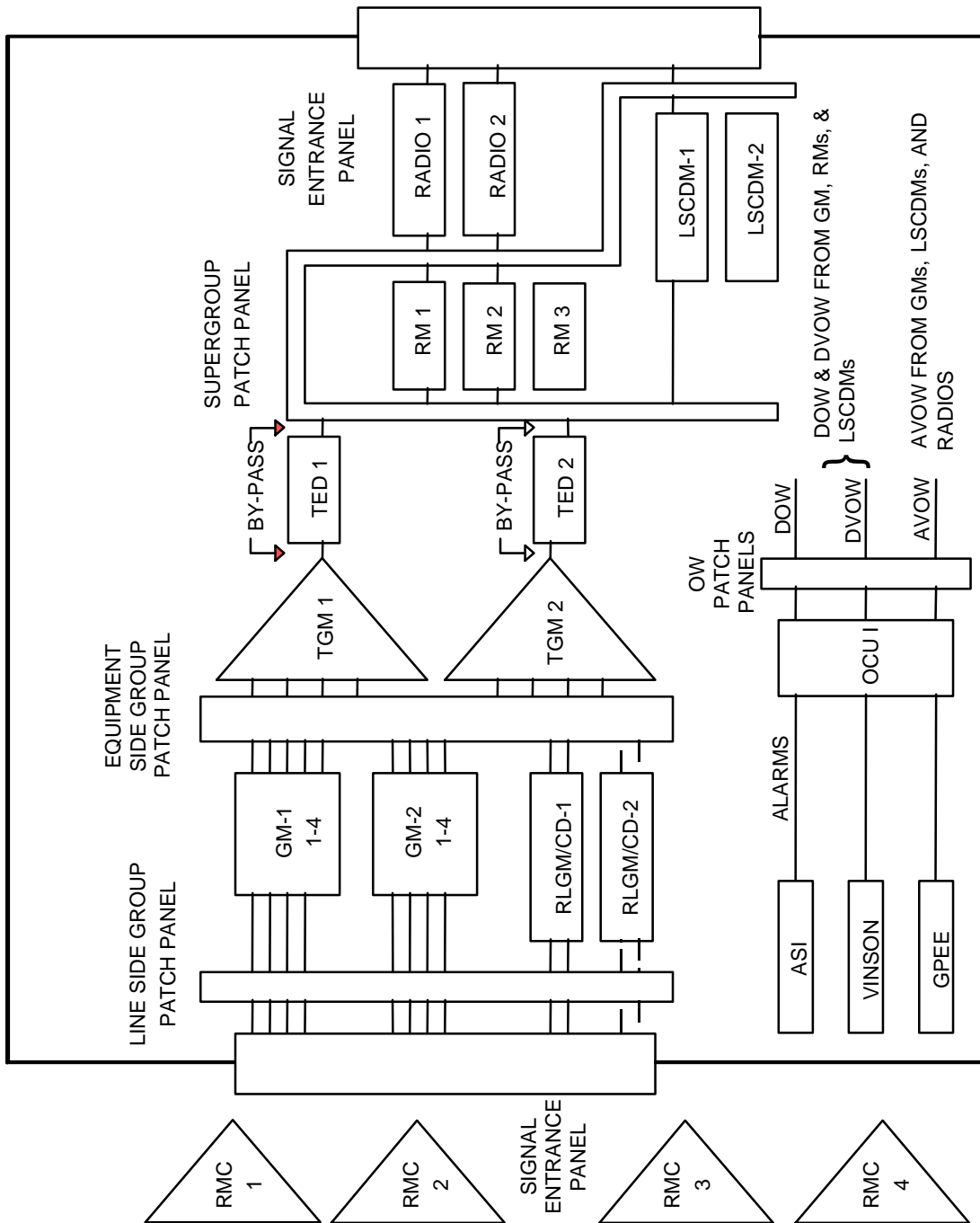
Figure F-B-1. AN/TRC-173 Functional Block Diagram

Table F-B-1. AN/TRC-173 Major Equipment Items

Equipment Item	Quantity
AB-1373, Antenna Mast	2
AB-1309, Antenna Mast	1
AN/GRC-103(V)4, Radio Set	2
AS-3047, Antenna	2
AS-1729, Antenna	1
C-10716, OCU-1	1
MD-1026, GM	2
MD-1023, LSCDM	1
MD-1025, RLGM/CD	1
MD-1065, RM	1
TD-1236, TGM	2
TD-1234, RMC	4
RT-524	1
KG-81, TED	2
KG-84(V)	1
KY-57	1
KY-68	1

3. AN/TRC-173 Characteristics

   a. AN/GRC-103(V)4 Radio. See Table F-B-2.

   b. MD-1023(P)/G LSCDM. One LSCDM is used to convert a CDϕ cable input into a NRZ data and timing signal and vice versa. It also provides power to up to 39 low-speed pulse restorers and accommodates AVOW, DVOW, and DOW. See Table F-B-3.

Table F-B-2. AN/GRC-103(V)4 Technical Characteristics

Characteristic	Value
Frequency	1.35-1.85 GHz (channels 2,300-3,300)
Range	Up to 48 km
Data Rates	640 or 1,280 Kbps
Modulation	FM
Receiver Sensitivity	-94 dBm @ 640 Kbps -88 dBm @ 1,280 Kbps
RF Output	+42 dBm (15 Watts) minimum

Table F-B-3. LSCDM Characteristics

Characteristic	Value
Range	Up to 1.6 km, unrepeatered in 0.4 km increments Up to 64 km with repeaters located no further than 1.6 km apart

Data Rates
 	
    Equipment Side
    Line Side
	
	72-2,048 Kbps (NRZ)
	2,304 Kbps (CDϕ)

Data Format
 	
    Equipment Side
    Line Side
	
	No Restriction
	LSCDM Block [1]

1/ Because of to the LSCDM block format on the line (cable) side, the distant end must also terminate into an LSCDM.

  c. MD-1026(P)/G GM. See Table F-A-4, Appendix A.

d. <u>MD-1065/G RM</u>. The RM provides the interface between the AN/GRC-103(V)4 and the DGM component NRZ signals. See Table F-B-4.

Table F-B-4. MD-1065/G Characteristics

Characteristic	Value
<u>Data Rates</u>	
Equipment Side	128-1,152 Kbps
Radio Side	640 Kbps for inputs to 576 Kbps
	1,280 Kbps for inputs over 576 Kbps

e. <u>TD-1234(P)/TC RMC Characteristics</u>. The four RMCs multiplex/demultiplex up to eight four-wire digital or analog terminals and accept a group from an RLGM or another RMC and bit interleave it with the local channels and vice versa. The RMC can furnish power for an RLGM connected to the low group. See Table F-B-5.

Table F-B-5. TD-1234 Characteristics

Characteristic	Value
Range	
<u>Loop Side</u>	
Digital	3.2 km
Analog	4.0 km
Line Side	3.2 km High/Low Group
Data Rates	
<u>Loop Side</u>	
Digital	16 or 32 Kbps
Analog	Nominal 4 kHz
FSK	1,200 Baud @ 32 Kbps VDR
<u>Line Side</u>	
High Group	128-576 Kbps
Low Group	72-288 Kbps

f. <u>TD/1233(P)/TTC RLGM Characteristics</u>. The RLGM/CD converts up to two RLGM CDφ inputs to NRZ data and timing and vice versa. See Table F-B-6.

Table F-B-6. TD-1233 Characteristics <u>1</u>/

Characteristic	Value

Range
  <u>Loop Side</u>
   Digital
   Analog
 	
  Line Side
	
	3.2 km
	4.0 km
	
	3.2 km

Data Rates
  <u>Loop Side</u>
   Digital
   Analog
   FSK
 	
  Line Side
	
	16 or 32 Kbps
	Nominal
	1,200 Baud @ 32 Kbps VDR
	
	72-144 Kbps

<u>1</u>/ RLGMs are not furnished as part of the AN/TRC-173. They are included here for completeness only.

4. <u>AN/TRC-173 Employment and Configuration</u>. The AN/TRC-173 is normally employed at Army extension nodes to provide service to concentrations of subscribers. Figure F-1, Enclosure F, shows an example where subscribers at ARSOF are provided connectivity to the common user network. This example shows the AN/TRC-173 utilized as a cable terminal. Crew assignment sheets and instructions for their use are found in Appendix D to Enclosure A.

APPENDIX C TO ENCLOSURE F

AN/TRC-174 RADIO REPEATER SET

1. <u>AN/TRC-174 Functional Description</u>. The AN/TRC-174 can function as a radio repeater, a cable-to-radio repeater, and if properly equipped, a cable-to-cable repeater. When employed at the TOH, the AN/TRC-174 can accommodate up to three GM-to-radio supergroups, each with a data rate of up to 1,152 Kbps (36 channels at the 32 Kbps VDR). Normally, only two supergroups are used, with the third radio acting as backup. When employed as a radio repeater, a single supergroup at the 1,152 Kbps or less may be repeated, again with the third radio acting as standby. The AN/TRC-174 can accommodate a single 1,152 Kbps supergroup when employed as a cable-to-radio repeater. The AN/TRC-174 is typically employed as shown in Figure F-1, Enclosure F.

2. <u>AN/TRC-174 Technical Description</u>

   a. The radio interface is provided by three AN/GRC-103(V)4 radio sets. Each radio has the capability to transmit and receive a supergroup of up to 1,152 Kbps (36 channels at the 32-Kbps VDR). The radios operate in the UHF Band IV range and have an LOS planning range of approximately 48 km (30 miles). Active Army Signal units are being equipped with the AB-1373 DAMP. A limited number of AB-1309 masts are being retained.

   b. The cable interface is provided through an LSCDM. The GM (MD-1026) also provides up to four cable interfaces for diphase and/or dipulse signal types. (See Enclosure B for additional information on the LSCDM and GM.)

   c. The cable-to-radio interface is provided through the combined use of the LSCDM, GM, and AN/GRC-103(V)4. Although the LSCDM and GM can accommodate digital groups of 2,048 and 4,608 Kbps respectively, radio bandwidth is limited to 1,152 Kbps (36 channels at the 32 Kbps VDR) thus restricting the cable-to-radio interface to a maximum of 1,152 Kbps. The AN/TRC-174 can support the cable-to-cable repeater functions simultaneously if equipped with two additional LSCDMs. Under normal conditions, only two radios are utilized while the third remains on standby. Figure F-C-1 is a functional block diagram of the

AN/TRC-174. Table F-C-1 lists the major equipment items in the AN/TRC-174(V).

    d. <u>AN/TRC-174( ) Technical Characteristics</u>

      (1) <u>AN/TRC-103(V)4 Radio</u>. See Table F-B-2, Appendix B.

      (2) <u>MD-1023(P)/G LSCDM</u>. See Table F-B-3, Appendix B.

      (3) <u>MD-1026(P)/G GM</u>. See Table F-A-4, Appendix A.

      (4) <u>MD-1065/G RM</u>. See Table F-B-4, Appendix B.

3. <u>AN/TRC-174 Employment and Configuration</u>. The AN/TRC-174 is normally utilized to terminate a group at the TOH from an extension node or to provide a repeater function. The AN/TRC-174 is not equipped with TEDs. Figure F-1 illustrates these functions (ARFOR TOH AN/TRC-174 and cable-to-radio repeater between ARFOR and ARSOF). The example configuration shown in Figure F-C-2 illustrates component connectivity to perform the function between the ARFOR and ARSOF crew assignment sheets and instructions for their use are found in Appendix D to Enclosure A.

Table F-C-1. AN/TRC-174(V) Major Equipment Items

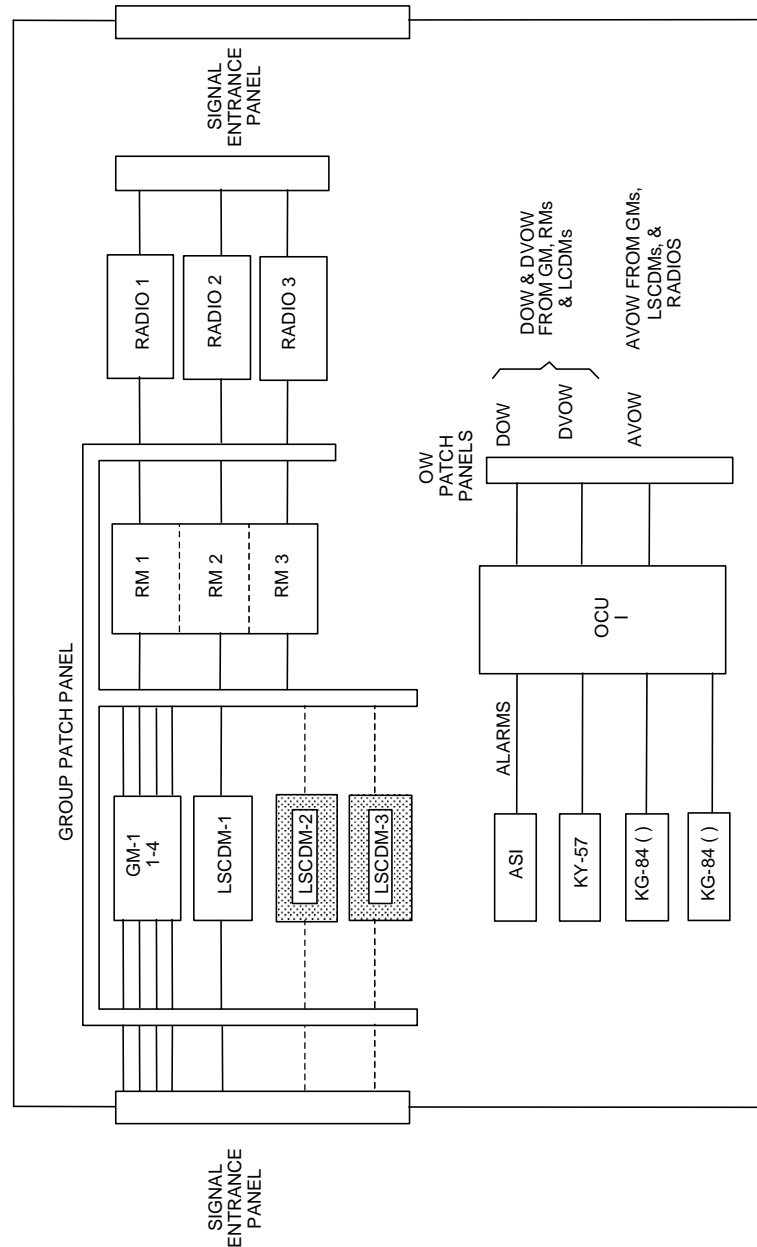| Equipment Item	Quantity
AB-1373, Antenna Mast	3
AB-1309, Antenna Mast	1
AN/GRC-103(V)4, Radio Set	3
AS-3047, Antenna	3
AS-1729, Antenna	1
C-10716, OCU-1	1
MD-1026, GM	1
MD-1023, LSCDM	1
MD-1065, RM	1
RT-524	1
KG-84(V), GPEE	2
KY-57, VINSON	1
KY-68, DSVT	1

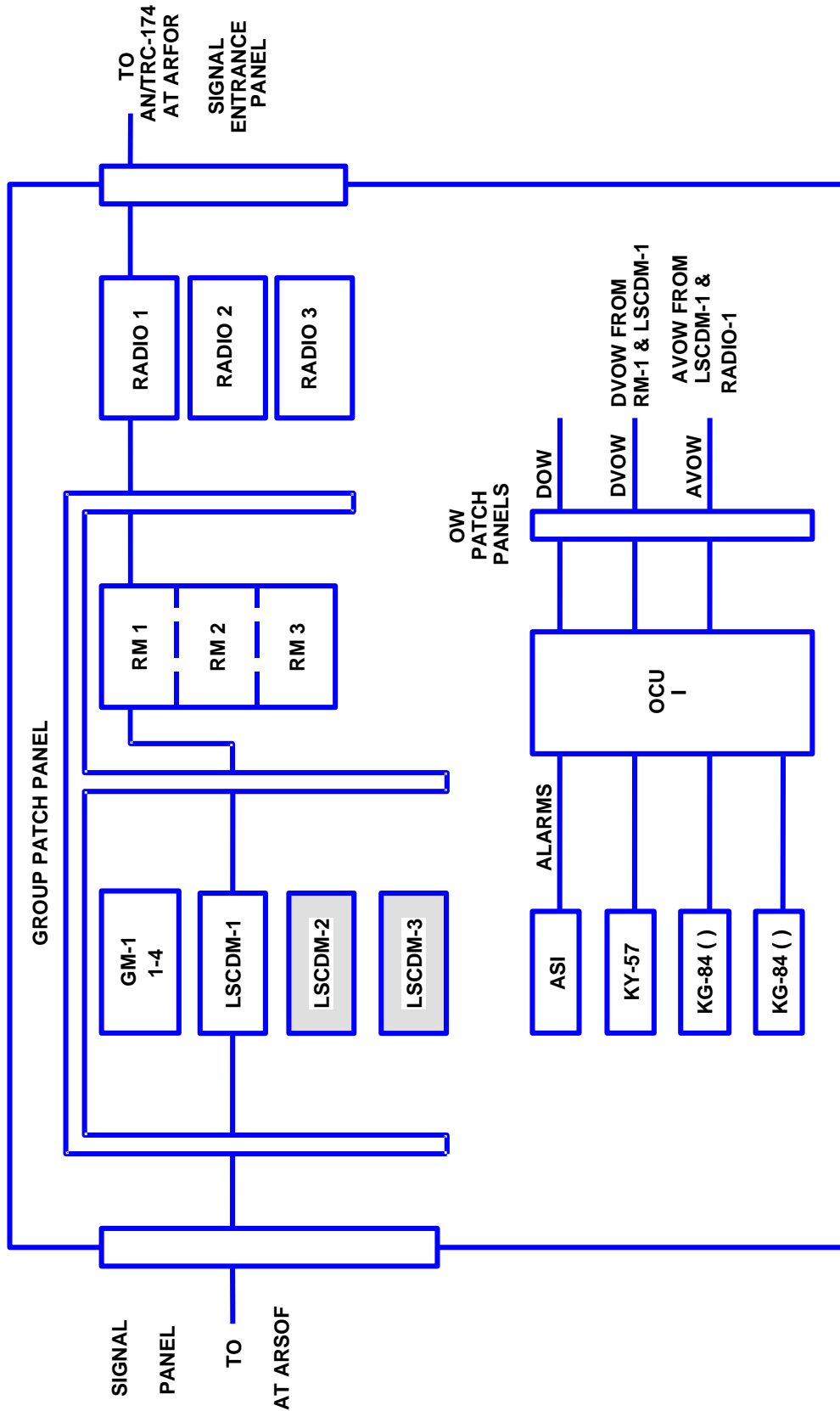Figure F-C-1. AN/TRC-174 Functional Block Diagram

Figure F-C-2. AN/TRC-174 Example Configuration

       Enclosure F

APPENDIX D TO ENCLOSURE F

AN/TRC-175 RADIO TERMINAL SET

1. <u>Functional Description</u>. The AN/TRC-175 can function as a radio or cable terminal for the link from the BOH to the AN/TRC-138A at the TOH. When used as one end of the BOH/TOH link, an integral second-level multiplexer combines up to 12 groups into a mastergroup and vice versa. The mastergroup is then connected to either a radio or a cable driver, as appropriate. Adequate equipment strings are provided to accommodate up to two separate systems, either radio or cable, or a combination of a radio and a cable system. The AN/TRC-175 is typically employed at Army node BOHs initially employing the radio system. A typical employment is illustrated in Figure F-1. As time permits, a cable system is installed and replaces the radio system.

2. <u>Characteristics, Capabilities, and Major Components</u>

    a. The radio interface is provided by two radio sets, AN/GRC-222. (See Appendix A.)

    b. The mastergroup cable interface is provided by the HSCDM. (See Appendix A.) The HSCDM can transmit and receive a 9.36- or 18.72-Mbps mastergroup up to 0.4 km (1/4 mile) over unrepeatered cable. With repeaters every 0.4 km the HSCDM can power up to 19 repeaters and drive an 8-km (5-mile) system. The HSCDM can also accommodate the 4,608 Kbps rate. The cable interface for groups at the lower rates is provided by the GM. The CX-11230A/G cable and the HSPR required for cable systems over 0.4 km (0.25 miles) are not component parts of the AN/TRC-175 radio assemblage. Interfaces for the AVOWs, DVOWs, and the DOW are provided by the OCU-II and appropriate DGM components.

    c. Figure F-D-1 is a functional block diagram of the AN/TRC-175 showing its major DGM, COMSEC, and radio equipment components. Table F-D-1 lists the major AN/TRC-175 equipment items.

3. <u>AN/TRC-175 Interface Characteristics</u>

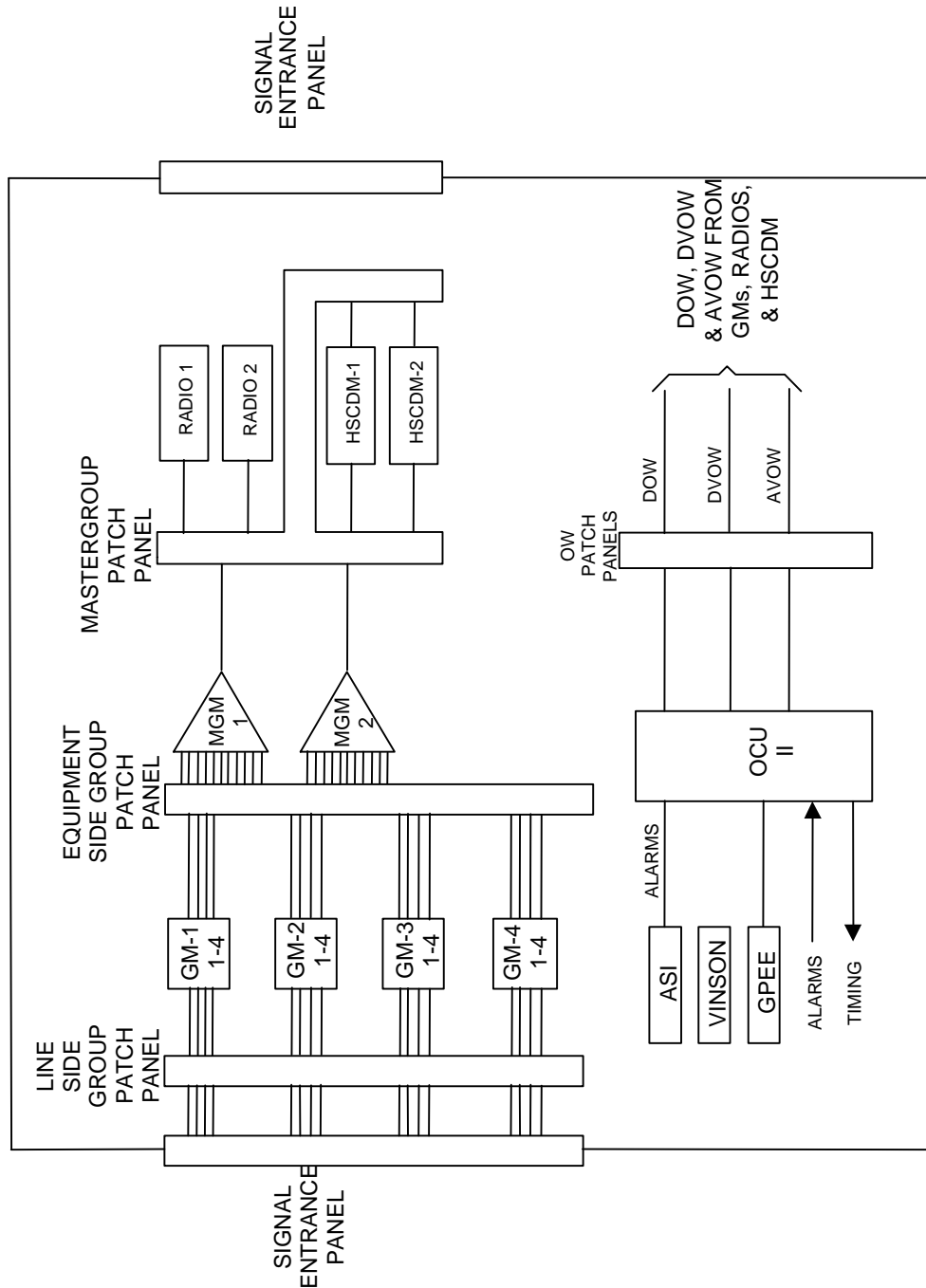   a. <u>AN/GRC-222 Radio</u>. See Table F-A-2, Appendix A.

Figure F-D-1. AN/TRC-175 Functional Block Diagram

Table F-D-1. AN/TRC-175 Major Equipment Items

Equipment Item	Quantity
AB-1373, Antenna Mast	2
AB-1309, Antenna Mast	1
AN/GRC-222, Radio Set	2
AS-1425, Antenna	2
AS-1723, Antenna	1
C-10717, OCU-1	1
MD-1026, GM	4
MD-1024, HSCDM	2
TD-1237, MGM	2
RT-524	1
KG-84( ), GPEE	1
KY-57, VINSON	1
KY-68, DSVT	1

    b. MD-1024(P)/G HSCDM. See Table F-A-3.

    c. MD-1026(P)/G GM. See Table F-A-4.

4. AN/TRC-175 Employment and Configuration

    a. The AN/TRC-175 is normally employed at the BOH in support of either a wideband radio or cable system to an AN/TRC-138A located at the TOH. Figure F-1 illustrates how the terminal may be employed in a joint network. The example configuration shown in Figure F-D-2 illustrates component connectivity to perform the radio terminal function at the ARFOR BOH.

    b. Crew assignment sheets and instructions for their use may be found in Appendix D to Enclosure A.
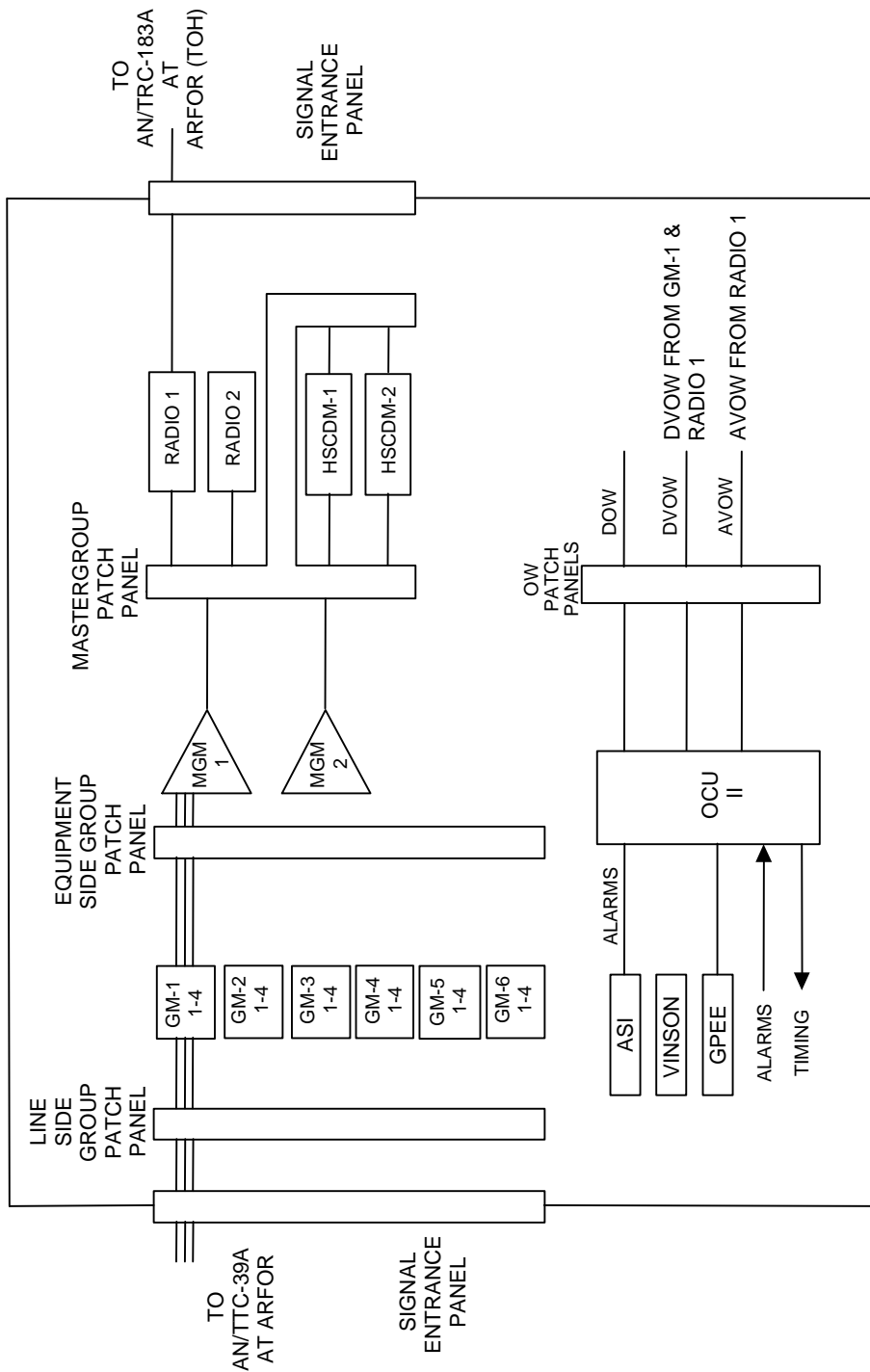
Figure F-D-2. AN/TRC-175 Example Configuration

APPENDIX E TO ENCLOSURE F

AN/MRC-142 LINE-OF-SIGHT RADIO SUBSYSTEM

1. Introduction. The AN/MRC-142 is a Marine Corps UHF multichannel terminal used by the Marine Expeditionary Force (MEF) and its major subordinate commands. Each AN/MRC-142 can provide two independent LOS links. It provides a radio link to interconnect ULCSs, AN/TTC-42 and SB-3865, or functions as a radio repeater (see Figure F-2).

2. Technical Description. The terminal is mounted on an M-998 variant of the HMMWV. The radio operates in the 1,350-1,850 MHz band. Table F-E-1 is a listing of the terminal components.

Table F-E-1. AN/MRC-142 Terminal Components

Designation	Description	Quantity
Rack Mounted Equipment		
RT-1601	UHF Receiver-Transmitter	2
CV-4089	Conditioned Diphase Adapter	2
KG-94A	Trunk Encryption Device	2
KY-57	VINSON Voice Security Device	1
Antenna Assembly		
AB-1356	Mast	2
AS-3964	Antenna	2
--	100 foot RF coax cable	2
Ancillary/Related Equipment		
TD-1234	RMC	1
AN/GSC-54	Fiber Optic Applique (FOA)	2

   a. RT-1601. The technical parameters of the radio are found in Table F-E-2.

Table F-E-2. RT-1601 Technical Characteristics

Characteristic	Value
Frequency Range (MHz)	1,350-1,850
Channel Spacing (kHz)	100 (125 optional)
Frequency Duplex Spacing (MHz)	63, single antenna
Channel Rate (Kbps)	144, 288, 576
Interfaces	NATO, AMI, HBD-3
Output Power	Low: 300 mW (25 dBm) High: 3 Watts (35 dBm)
Frequency Stability	10 ppm
Receiver Threshold Sensitivity @ BER = 1x 10^{-4} (dBm)	-93
Orderwire Channel	Analog: 300-3,400 Hz Digital: 16 Kbps

   b. <u>Conditioned Diphase Adapter ,CV-4089</u>. The CDA provides the required interface between a ULCS, RMC, or FOA and the RT-1601 radio. In addition, it provides the following functions. Table F-E-3 lists the principal electrical characteristics of the CDA.

      (1) Plain and encrypted traffic interface with the KG-94A, monitor the incoming radio bit stream for a TRI-TAC frame pattern, and initiate TED resync when frame pattern is lost.

      (2) I/O audio and call functions for DVOW, over the radio side; through the KY-57 VINSON and AVOW over the cable side.

   c. <u>KG-94A</u>

   d. <u>KY-57</u>

   e. <u>AB-1356, Mast</u>. The AB-1356 is a collapsible, telescoping 50-foot antenna mast.

   f. <u>Antenna</u>. Following are the principal characteristics of the AS-3964 antenna.

Table F-E-3. CDA Electrical Characteristics

Characteristic	Value
Trunk/Loop Rates (Kbps)	576/32, 576/16, 288/32, 288/16, 144/16
Cable Side Equalization	Automatic for lengths up to 2 miles of CX-112302
Interfaces	
Cable Side	CDφ with AVOW superimposed. Compatible with RMC, ULCS, and FOA.
Radio Side	Provides transmit balanced NRZ data and clock to radio and accepts received balanced data and clock from radio. Provides and accepts to/from radio DVOW, 16 Kbps digital signals, and associated DVOW CALL and CALL RECEIVED signals.
KG-94A	Provides and accepts to/from the KG-94A all required Transmit/Receive, cipher/plain, data and clock signals, resync command, and BLACK Station Clock.
KY-57	Provides required interface between KY-57 and the radio for cipher text IN/OUT. Provides plain audio IN/OUT and push-to-talk to KY-57, from either handset in DVOW mode or AVOW in orderwire bypass mode.

(1) Open grid reflector.

(2) Gain: 20 dBi

(3) Beamwidth: ±7.5°

(4) Polarization: Horizontal or vertical.

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APPENDIX F TO ENCLOSURE F

MSE RADIOS AND ASSEMBLAGES

1. <u>Introduction</u>. The MSE system utilizes two types of LOS multichannel radio equipment: UHF and SHF. These radio sets are components of the AN/TRC-190(V) and AN/TRC-198 LOS multichannel radio assemblages or the SEN (AN/TTC-48(V)) switching assemblage. (See Figure F-3.)

2. <u>LOS Radio Assemblages</u>

   a. <u>AN/TRC-190(V) LOS Multichannel Radio Assemblage</u>. There are four versions of the AN/TRC-190(V).

      (1) The LOS A(V)1 provides a primary UHF radio link between RAU, SEN, and the node NCS through an LOS A(V)3.

      (2) The LOS A(V)2 provides the capability to relay NCS signaling received from an LOS A(V)3 to NATO forces through a cable link using the NATO analog interface (NAI) converter.

      (3) The LOS A(V)3 provides radio communications links between the NCS and the other LOS versions, which, in turn, provide links to other node centers, RAUs, SENS, LENS, and NATO/A(V)3s. It also serves as a digital NATO interface (DNI) and can serve as a radio relay.

      (4) The LOS A(V)4 provides radio links from a LEN to two NCSs through two LOS A(V)3s. The LOS A(V)4 can also serve as a radio relay.

   b. <u>AN/TRC-198(V) LOS Multichannel Radio Assemblage</u>. The AN/TRC-198(V) is the LOS assemblage employed as part of the MSE contingency communications package (CCP). There are two versions, the AN/TRC-198(V)1 is employed at the contingency communications parent switch (CCPS), while the dismounted AN/TRC-198(V)2 is employed at the contingency communications extension switch (CCES).

3. <u>MSE LOS Multichannel Radios</u>

   a. <u>AN/GRC-226, UHF Radio Set</u>. The AN/GRC-226(V) is used to establish primary multichannel links. The nominal planning range for the AN/GRC-226 is 25 km. Table F-F-1 lists the radio's technical characteristics.

Table F-F-1. AN/GRC-226 and Antenna Technical Characteristics

Characteristic	Value
Radio Characteristics	
Frequency Range (MHz)	
Band I	225-400
Band III	1,350-1,850
Channel Spacing (kHz)	125 (min.)
Minimum TX/RX Spacing (kHz)	50
Modulation	CPFSK
Emission Bandwidth	
1024 Kbps	1.2 MHz
512 Kbps	600 kHz
256 Kbps	300 kHz
Power Output	
Band I	High: 10 Watts
	Low : 1 Watt (Nominal)
Band III	High: 5 Watts
	Low : 0.5 Watts
Noise Figure (dB)	Band I: 7
	Band III: 8
Modulation Index	
256 Kbps	1.0
512/1024/2048 Kbps	0.5
Group Data Rates (Kbps)	256, 512, 1024, 2048
Emission Bandwidth (kHz)	
256 Kbps	400
512 Kbps	400
1024 Kbps	800
Antenna Characteristics-Band I	
Antenna Gain (dBi)	20
Beamwidth	±35°
Input Power (Watts)	25 (max.)
Antenna Characteristics-Band III	
Antenna Gain (dBi)	21
Beamwidth	±6.5°
Input Power (Watts)	15 (max.)

(1) The AN/GRC-226 is a fully frequency-synthesized, microprocessor-controlled, transportable digital radio. The selection of operating frequencies is carried out under microprocessor control using a

12-button keypad. Each frequency may be initially set up or changed in approximately 3 to 10 seconds. Continuous-phase frequency shift keying (CPFSK) modulation is used to conserve RF bandwidth.

(2) The radio set is divided into two cases: diplexer and RF unit and baseband unit. The baseband unit is common to both frequency bands. The radio operates in Band I, 225-400 MHz, and Band III, 1,350-1,850 MHz. The diplexer and RF unit is tailored to the specific band. Monitoring, testing, and channel changing are achieved using the keypad and digital character display.

(3) Baseband Unit. This unit contains the complete radio power supply together with the circuitry for:

(a) A second IF amplifier and bit rate filters.

(b) Data and EOW channel demodulation.

(c) EOW transmit constant volume amplifier, receive audio amplifiers, and tone calling circuitry.

(d) Data reconstitution, premodulation filtering, and data interface conversion.

(4) Diplexer and RF Unit. This unit contains all the microprocessor and control circuitry and final frequency RF circuitry to provide:

(a) Transmit Synthesizer and voltage controlled oscillator (VCO).

(b) Receive Synthesizer and VCO.

(c) Receive front end, first IF amplifier, and filters.

(d) Transmit power amplifier.

(e) Transmit modulation control.

(f) Synthesizer frequency control and memory.

(g) Transmit and receive filters and associated coaxial relays.

(5) A 16-Kbps DVOW is used to communicate EOW information. Access and control are provided by the DVOW function of the Communication Modem, MD-1270, and VINSON.

(6) Electrical performance is continuously monitored by the microprocessor. If a fault is detected, visual and audible alarms are generated. When the operator interrogates the microprocessor by pressing the BITE key, any detected fault condition is displayed by a specific identification number.

(7) Five loop tests can be set up by the operator using the keypad to test the local equipment and the interconnecting link.

   b. AN/GRC-224, SHF Radio Set. The SHF radio, AN/GRC-224, functions as a DTH, short-range system in tandem with the primary UHF links. The radio has a nominal planning range of 5 km. Table F-F-2 is a listing of technical characteristics.

Table F-F-2. AN/GRC-224 and Antenna Technical Characteristics

Radio Characteristics	
Characteristic	Value
Frequency Range (GHz)	14.35-15.5

Frequency Subbands (GHz)
     Subband L
     Subband M
	
	14.648- 14.816
	15.033- 15.201

Subband Width (MHz)	Approx. 100
Channel Spacing (MHz)	3.5
Modulation	FSK
Power Output (Watts)	200 mW (23 dBm) @ 4,096 Kbps
Antenna Characteristics	
Gain- Main Lobe (dBi)	36.5 dBi
Beamwidth	2.2° (E-plane) 2.4° (H-plane)

(1) The SHF radio consists of two units. The RF Unit is mounted atop 9-meter mast, and consists of transmitter and receiver electronics. The electronics are packaged in a weather-tight enclosure, integrally attached to a 2-foot parabolic antenna. The Control Unit is located within selected LOS assemblages and NCS, LENS, and SENS. It contains the electronic circuits, controls, and display components that facilitate operation and monitoring of radio and RF link performance. It also contains the provisions for interface with the DTG and orderwire and mast-mounted RF Unit. The two units can be separated by up to 200 meters.

(2) The radio can operate in eight subbands; however, only two bands are used with MSE. Each subband contains between 27 and 30 possible channels. The radio can operate in any one of four data rates: 256, 512, 1,024 or 4,096 Kbps. For each data rate, the control subsystem automatically selects the appropriate IF bandwidth and alarm threshold. All frequency and data-rate parameters are selected using a numeric keypad on the Control Unit.

c. <u>MSE Multichannel LOS Radio Assemblages Equipment Complement</u>. Table F-F-3 lists the complement of radio equipment in each LOS assemblage. The other major equipment item present in each assemblage is the communications modem MD-1270 and KY-57. Figure F-3 depicts the employment of MSE LOS terminal assemblages.

Table F-F-3. MSE Multichannel Radio Assemblage Configurations

Radio Equipment	AN/TRC-190 Configuration				AN/TRC-198 Configuration	
	A(V)1	A(V)2	A(V)3	A(V)4	(V)1	(V)2
AN/GRC-226						
Baseband Unit	2	2	3	2	3	1
RF Unit Band I	1	1	2	1	3	1
RF Unit Band III	1	1	2	1	3	1
Antenna Band I	1	1	2	1	3	1
Antenna Band III	1	1	2	1	3	1
15 Meter Mast	1	1	3	2	3	1
30 Meter Mast	--	--	1 per NC	--	--	--
SHF Radio, AN/GRC-224	1 (Optional)	--	1 (Optional)	2	--	--
Employment	SEN, Remote RAU; ADA Bde & Bn	Remote NAI, NATO CRC	NC, Radio Relay	LEN; ADCOM HQ & SUPCOM	CCPS	CCES

APPENDIX G TO ENCLOSURE F

DCS-TACTICAL LOS TRANSMISSION INTERFACE

1. Introduction. The DCS-tactical LOS transmission interface provides a digital voice channel and digital group interconnection between selected facilities of the digital DCS and tactical elements employing TRI-TAC/MSE transmission rates of 16, 32, 256, and 512 Kbps (see Figure F-G-1). The digital interconnections augment the planned analog voice frequency (VF) tactical interconnections at selected DCS VF termination points and permit TRI-TAC- and MSE- equipped units to route digital traffic at various data rates through the DCS. Required interface equipment is positioned at selected DCS technical control facilities and designated commercial interface points.

2. Technical Description

   a. AN/FCC-100(V). The LDRM provides the interface between the 16-and 32-Kbps CDϕ signal originated by the TRI-TAC/MSE and NRZ signals required by the AN/FCC-98 first-level digital multiplexer.

   b. MD-1026, Group Modem. The MD-1026, which is capable of operation at selected rates between 72 and 4,608 Kbps, converts a 512 Kbps DTG or a fiber optic CDϕ group signal transmitted by coaxial cable from the TRI-TAC or MSE assemblage to the NRZ format for the AN/FCC-98.

   c. AN/FCC-98 Digital Multiplexer. The AN/FCC-98 is a first-level multiplexer and demultiplexer with a 3-, 6-, 12-, or 24-channel capacity. Each of the 24 channels can be a voice channel. Up to 12 voice channels can be replaced by a selective mixture of synchronous, asynchronous, or isochronous data channels by unplugging a voice channel module and inserting the appropriate data channel module.

   d. MD-1272, Fiber Optic Modem. The FOM provides the NRZ format conversion, which is also performed by the GM.
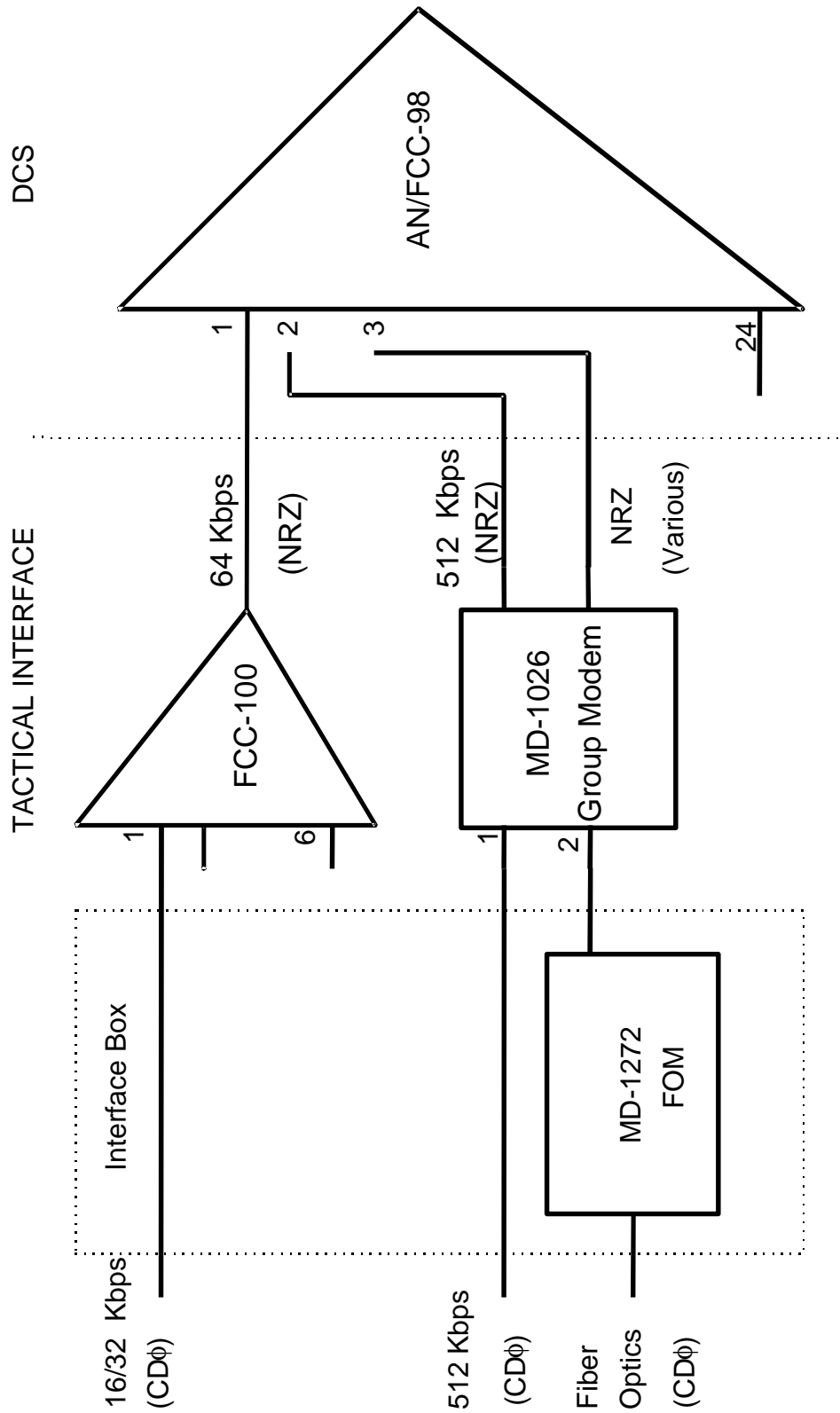
Figure F-G-1. DCS-Tactical Transmission Interface Block Diagram

ENCLOSURE G

HIGH FREQUENCY RADIO SYSTEMS

1. <u>General</u>. The initial C2 used to support joint deployment and exercises may be established through the use of HF radio transmission links. These links provide point-to-point communications circuits among the JTF, joint special operations task force (JSOTF), the DCS, and Service components as depicted in Figure G-1. Essential circuits and trunks are established for access to the DSN, AUTODIN, or other major command headquarters. In addition to providing initial C2 capabilities, the HF links serve as backup communications for established satellite and/or terrestrial links. HF radio equipment used to support the links includes the AN/TSC-60(V)-2, -3,-5,-6, and,-9 and the AN/TSC-120 and -122. The AN/TRQ-35 HF Radio Sounder Set is used at major locations to optimize the link operating frequency.

2. <u>AN/TRQ-35(V) Ionospheric Sounder</u>. The AN/TRQ-35(V) system is composed of three subsystems: the T-1373 transmitter, the R-2081 receiver, and the R-2093 spectrum monitor. The system requires the use of the one receiver with one to three transmitters. The spectrum monitor does not require the simultaneous use of either the transmitter or the receiver.

   a. <u>Transmitter</u>

     (1) The T-1373 transmitter transmits a continuous wave (CW) signal that is swept linearly between 2-16 MHz or 2-30 MHz in 4 minutes and 40 seconds. The maximum power output is 100 W (a selectable attenuator can reduce the power output to 10 Watts). If the diplexer is employed to allow the use of a common antenna with the communications transmitter, only 2 percent of the sounder transmitter power is coupled onto the antenna, and the remaining power is dissipated in an internal dummy load. The sounder also is restricted by the characteristics of the communications transmitter antenna, which may be narrowband and directional. These antenna parameters would identify the actual operating characteristics of the link involved, but could affect the usefulness of the sounder system elsewhere in
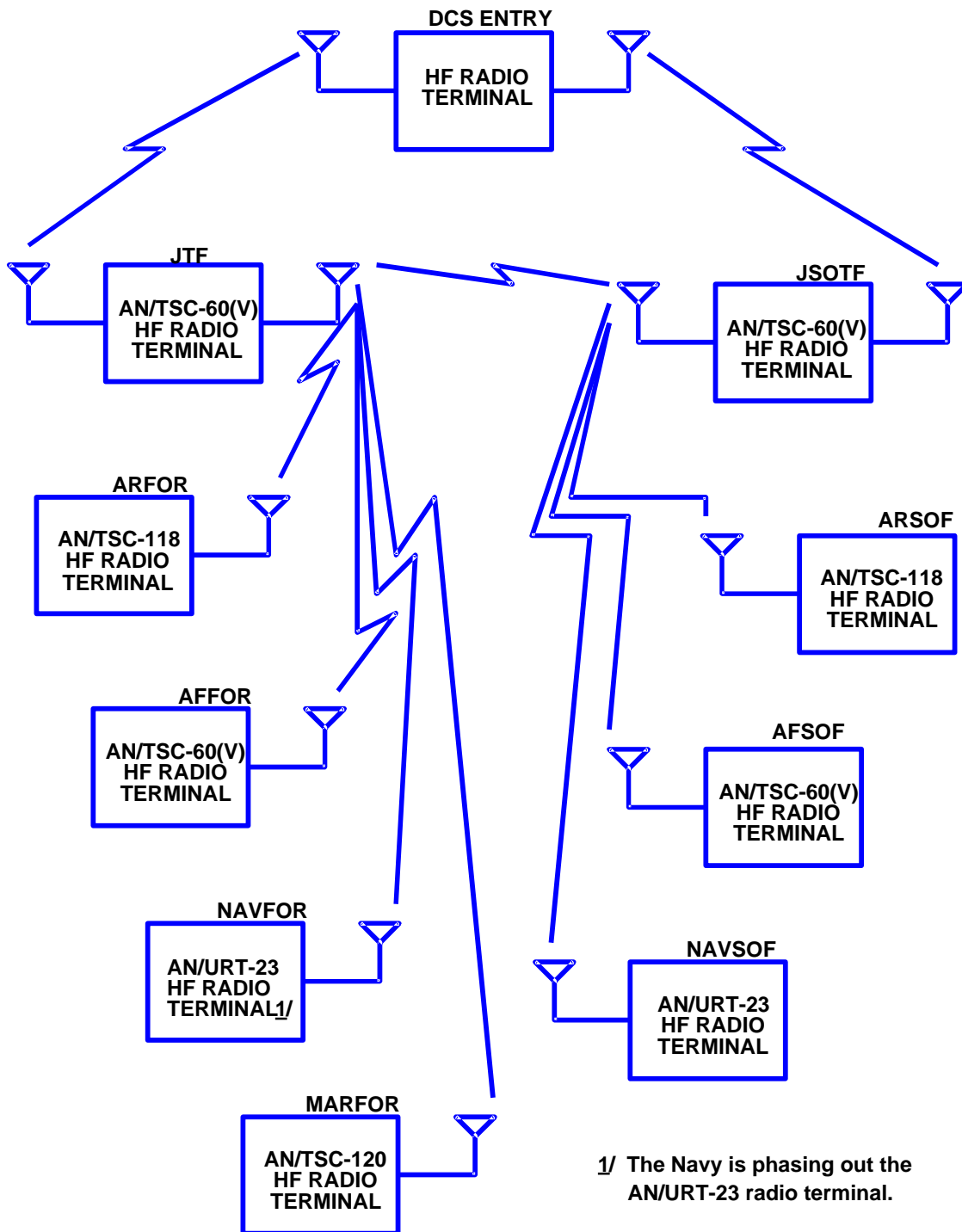
Figure G-1. HF Radio Link Network

the operating area. The communications transmitter power output cannot exceed 2.5 kW if the diplexer is to be used. Switches are provided in the transmitter to select a sweep ON or OFF at each 5-minute interval in the hour. Switches also permit blanking out up to 16 frequencies to prevent interference to authorized frequencies such as distress and international time frequencies.

(2) A transmitter may be collocated with other communications equipment or may be completely detached as long as it has the required power source. The transmitter operates unattended after initial programming and time synchronization. The antenna utilized should be broadband and have a high-takeoff angle since most tactical HF communications use near-vertical incidence.

b. Receiver. The R-2081 Receiver sweeps the HF spectrum in synchronism with the sounder transmitter. This process allows the receiver to have an extremely narrow bandwidth, which offers tremendous immunity to interference from other users. A cathode ray tube (CRT) display provides a visual representation of the strength of the received signal and the time delay because of the propagation path. The time display can be interpreted to determine the mode by which propagation is achievable. Propagation by more than one mode (known as multipath) normally results in interference that is exhibited as fading. The display of only one mode of propagation is desirable for selection of the optimum usable frequencies. The receiver can store and display data from up to three separate transmitters. A sound receiver may be collocated with an HF communications receiver or operated completely detached. It may share an antenna with the collocated receiver or use a separate antenna. The antenna should be wideband and nondirectional if more than one transmitter is being used. After time synchronization and initial programming have been completed, no operational requirements exist except for interpretation of the displayed data.

c. Spectrum Monitor. The R-2093 Spectrum Monitor is an HF receiver, processor, and display system that presents a visual representation of the occupancy statistics of 6-kHz wide channels through the HF band. The entire HF spectrum is scanned every 10 seconds and results are compiled and updated in 5-minute and 30-minute time blocks. A 100- or 500-kHz width spectrum is displayed

around a selected center frequency and the resulting histogram depicts occupancy of each 6-kHz channel. Selection is provided for any of four different received power thresholds spaced by 10 dB. The resulting analysis shows the frequency of occurrence of the crossing of the selected threshold. The operator can select, by pushbutton control, and view received signal amplitude expressed in dBm and percentage of selected center frequency using internal speaker or headphones: selectable upper sideband (USB), lower sideband (LSB), AM, or FM. The spectrum monitor may be located wherever a power source and an antenna are available. No synchronization is required so that the operator is only required to turn on and interpret the display. Collocation of the sounder receiver and spectrum monitor provides the operator with the necessary information (received signal strength, lack of multipath occurrence, unused or minimally used frequencies) to enable selection of the optimum frequencies.

3. <u>AN/TSC-60(V)2 and (V)3 HF Communications Central</u>. The AN/TSC-60(V)2 is a dual 2.5-kW system that provides ground point-to-point or ground-to-air HF communications. The AN/TSC-60(V)3 is a 10-kW system with a second radio that may function independently and operate with its own antenna or remain in a standby mode (at 2.5 kW).

   a. The two independent radio sets are capable of operating in the following selectable modes: USB, LSB, independent sideband (ISB), compatible AM, and CW telegraph. Provisions are made for control and monitoring of each radio from a remote location at distances of 1,250 feet.

   b. The AN/TSC-60(V)3 requires an additional shelter to house the 10 kW PEP amplifier. The types of antennas provided are listed in Table G-1. Technical characteristics are listed in Table G-2.

4. <u>AN/TSC-60(V)5 Communications Central</u>. The AN/TSC-60(V)5, is a dual 2.5-kW system that can function with the OZ-11A/TSC-60(V) Radio

Table G-1. AN/TSC-60(V) Series Antenna Configuration and Power Output

Communications Center	Power Output (kW)	Transmitter Antenna Configuration
AN/TSC-60(V)2	2.5	OE-85, Log Periodic (3kW) AS-2481, Orthogonal (XMIT) AS-2482, Orthogonal (RCV)
AN/TSC-60(V)3	10 for one radio; second radio 2.5, can operate independently or remain in standby mode.	AS-2481 OE-86, Log Periodic (10 kW) OE-85 AS-2482
AN/TSC-60(V)5	2.5 or average RF output	OE-85 AS-3550, Orthogonal (XMIT) AS-2482
AN/TSC-60(V)6 1/	10	OE-86 OE-85 AS-2482
AN/TSC-60(V)9	1 or average RF output	AS-2459, Whip AS-2259, NVIS AS-2482

1/ The AN/TSC-60(V)5 when interconnected with the
    OZ-11A/TSC Radio Set Group is nomenclatured
    AN/TSC-60(V)6.

Table G-2. AN/TSC-60(V)2 and (V)3 Technical Characteristics

System Capabilities and Limitations	
Channel Capability	Up to 8 speech channels
	Up to 8 speech plus TTY channels
	8 TTY channels nondiversity or
	4 TTY diversity channels to replace a speech or speech plus TTY channel
Digital Data Capability	Compatible with rates up to 2.4 Kbps with an appropriate modem
System Capabilities and Limitations	
<u>Telephone Circuits</u>	
Ringing Frequency (Hz)	20-50
Ringing Voltage (VAC)	12-130
Input and Output mpedance (ohms)	600 balanced
Voice (Hz)	
	300-3,000
Radio In-band Signaling	1,600-2,600 Hz AM or FM 2,150-2,450 Hz shifted at 69 Hz rate +4 to -25 dBm receive and 0 to -4 dBm send
Teletype Terminal	
TTY Rate (wpm)	60, 75, or 100
Channels	8
<u>FSK Center Frequencies (Hz)</u>	
Subscriber Input	1,275
Radio Multiplex	2,805
Frequency Deviation (Hz)	±42.5
Levels (dbm)	0 to -30
<u>Keying Inputs</u>	
Direct Current	20 or 60 mA neutral, 20 mA polar
Limitation	Channels must be all polar or all neutral

Set Group to provide a 10-kW power output. In this case, the assemblage is nomenclatured the AN/TSC-60(V)6.

    a. The AN/TSC-60(V)5 is a transportable HF communication system providing dual 2.5 kW transmission capability. The system uses four-channel HF-80, AN/TSC-60(V) series antenna configuration and power output equipment and is compatible for use in DCS entry applications. The equipment is protected at the system level and provides a highly reliable communication system for optimum operation in tactical military environments.

    b. The AN/TSC-60(V)5 provides full-duplex voice and data communication. Modes of operation include ISB, SSB, voice, CW, multichannel TTY, AM, and compatibility with TADIL-A data links. The antenna complement for the system includes a transmit orthogonal antenna, a receive orthogonal antenna, and three log periodic directional antennas. (See Table G-1.)

    c. The system is housed in an S-141 modified shelter.

    d. The AN/TSC-60(V)5 can be locally controlled from the receiver and exciter front panel, or from the shelter-mounted remote control. The remote control may also be removed from the shelter to operate from a maximum distance of 381m (1,250 ft). The system consists of two receivers, two exciters, two 2.5-kW power amplifiers, voice frequency telegraph (VFTG) terminal equipment, and a telephone converter. Operation in conjunction with the OZ-11A/TSC-60(V) allows 10-kW power output for one four-channel radio system.

    e. The BITE capability to the circuit card and modem level is provided by the status display on the radio remote control unit and by the performance monitor built in to each 2.5-kW power amplifier.

    f. A block diagram of the AN/TSC-60(V)5 system is depicted in Figure G-2. Technical characteristics of the AN/TSC-60(V)5 are provided in Table G-3.
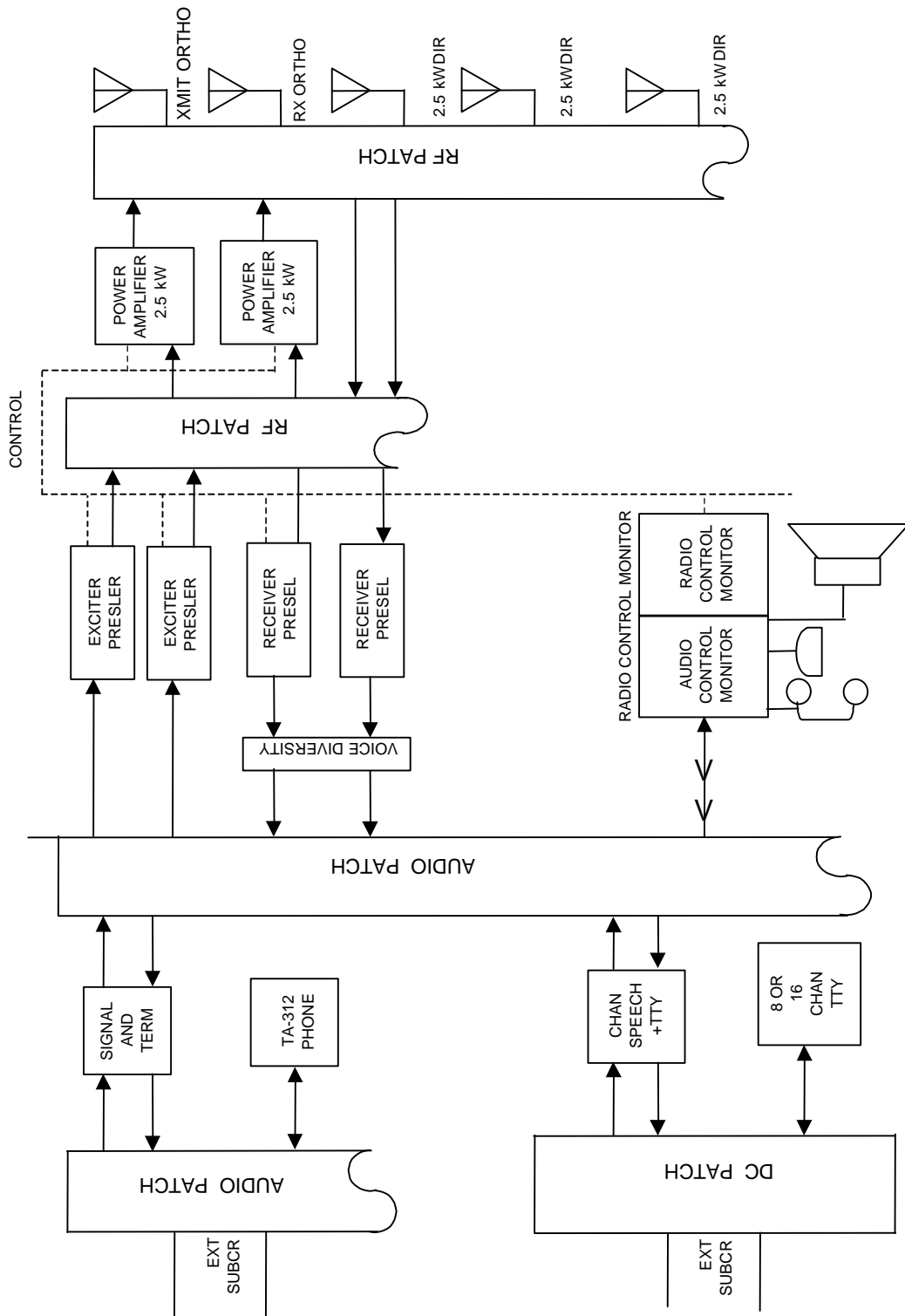
Figure G-2. AN/TSC-60 (V)5 Simplified Block Diagram

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Table G-3. AN/TSC-60(V)5 Technical Characteristics

Operational Characteristics	
Transmitter Power	2.5 PEP or average RF output
Frequency Range (MHz)	2.0-29.9999
Tuning Increments	0.1
Tuning Mode	Fully Automatic
Frequency Stability	$\geq$1 part in 10^8 over specified temperature range
Frequency Tune Time (Transmitter)	6 sec nominal, 10 sec maximum
Frequency Tune Time (Receiver)	1 sec nominal, 3 sec maximum
Channels	Four 3 kHz audio channels per radio
Information Types	ISB, USB or LSB, and CW
Audio System	
External Lines (local battery)	Eight each, two or four wire
Line Signaling (ring through)	Eight lines, 20 or 50 Hz
Radio Signaling	Eight lines, switchable (ring through) to 1,600 Hz or an FM 2,150/2,450 Hz signal shifted at 69 Hz rate.
Telephone	TA-312/PT
VFTG Terminal Equipment	
Speech-Plus TTY	Eight speech, plus eight TTY channels (85 Hz shift) at 2,805 +425 Hz
TTY Terminal	16 Channels (85 Hz shift) VFTG (switchable to 8-channel diversity and split operation)
Data Circuits	All loops full duplex compatible with 60/20 mA neutral or 20 mA polar DC circuits and 1,275 + 42.5 Hz VFTG audio circuits
Loop Supply	Loop battery provided for all lines; external battery operation is selectable

5. <u>OZ-11A/TSC-60(V) Radio Set Group</u>. The OZ-11 is a transportable shelter containing a 10 kW power amplifier for use with the AN/TSC-60(V)5. The antenna complement consists of one log periodic directional antenna. The OZ-11 is normally controlled locally from the AN/TSC-60(V)5 shelter. Provisions are made in the OZ-11 shelter for internally connecting the (V)5 radio control monitor unit and controlling the system from the OZ-11 shelter. (See Figure G-3 and Table G-4.)

6. <u>AN/TSC-60(V)9 Communications Central</u>. The AN/TSC-60(V)9 is an HF communications system providing a dual 1-kW transmission capability. The system uses four-channel HF-80 equipment and is compatible for use in DCS entry applications.

   a. <u>System Description</u>. The AN/TSC-60(V)9 provides full-duplex voice and data communications in the HF band. Table G-5 is a listing of technical characteristics. The TSC-60(V)9 can be locally controlled from the receiver and exciter front panels or from a shelter-mounted remote control. The remote control can also be removed from the shelter to operate from a distance of 7 km. The system consists of two receivers, two exciters, two 1-kW power amplifiers, VFTG terminal equipment, a telephone converter, two AS-2459/TSC-60(V) whip antennas, and transmit and receive orthogonal antennas (see Figure G-4 and Table G-1).

   b. <u>OG-190/TSC-60(V), Amplifier-Indicator Group</u>. The OG-190 is a transportable shelter containing a 10 kW power amplifier. It is used to increase the output power of the AN/TSC-60(V)5, (V)6, (V)9, or AN/TSC-122. When used with the AN/TSC-118, it provides dual or backup 10-kW capability. The OG-190 is normally controlled locally from the AN/TSC-60(V)5, (V)6, (V)9, AN/TSC-118, or AN/TSC-122. However, provisions are made in the OG-190 shelter for internally connecting the aforementioned assemblages' radio control monitor unit and controlling the system from the OG-190 shelter. The OG-190 has the same technical characteristics as the OZ-11 (Table G-4), except for the antenna which is a 10-kW directional tactical antenna.

7. <u>AN/TSC-120 Communications Central</u>. The AN/TSC-120 is a transportable communications central housed in an S-788/G lightweight, multipurpose shelter-mounted on an HMMWV.
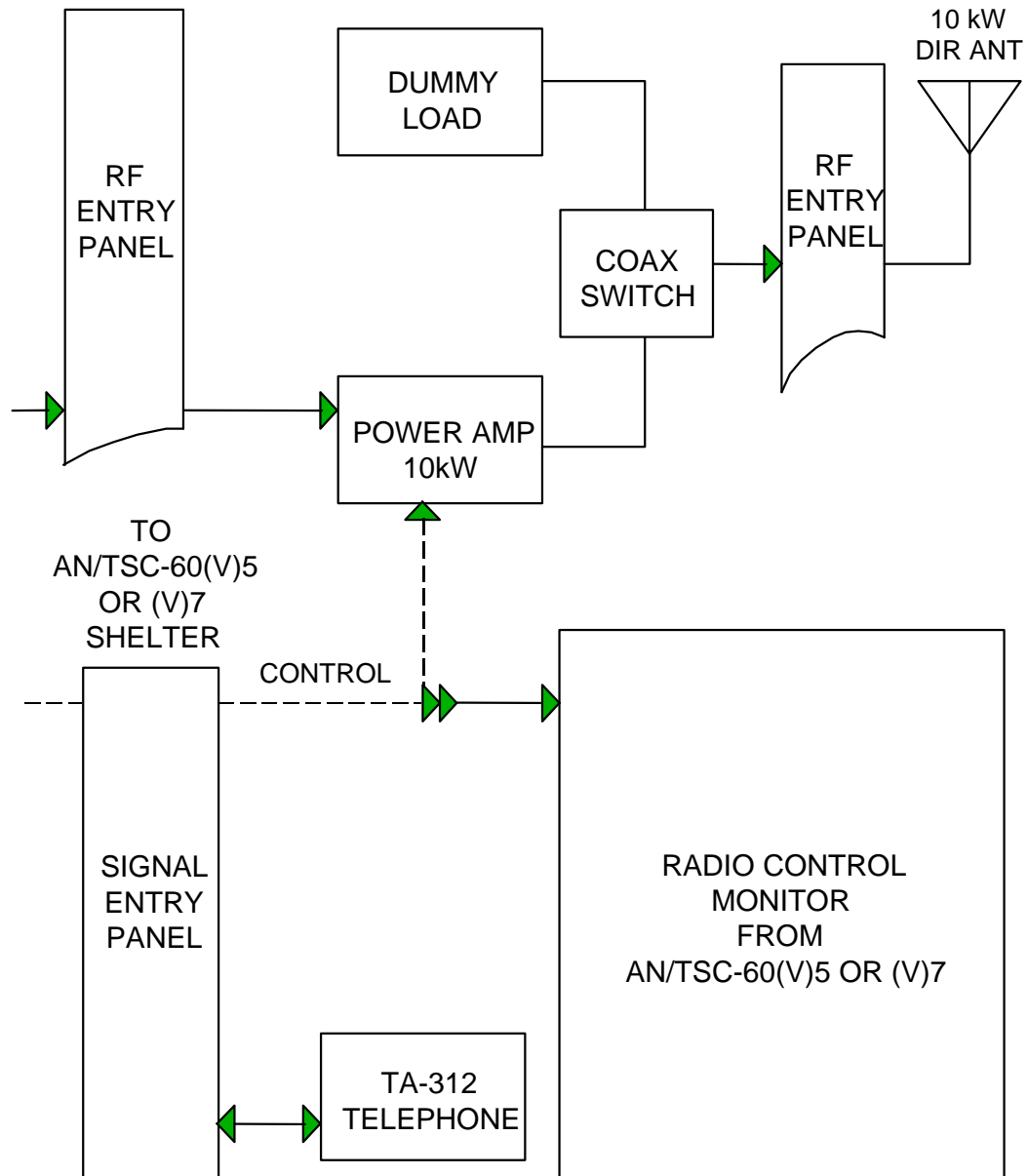
Figure G-3. OZ-11A/TSC-60(V) Radio Set Control Group

Table G-4. OZ-11A/TSC-60(V) Radio Set Group

Characteristics	Value
Transmitter Power (kW)	10 PEP or average RF output
Frequency Range (MHz)	2.00000 - 29.9999
Tuning Mode	Fully automatic
Frequency Tune Time (sec.) 1/	6 nominal, 10 maximum

1/ Transmitter tuning time includes exciter, preselector, and coupler.
Implementation of options reduces tune time to be compatible with
adaptive communications techniques.

Table G-5. AN/TSC-60(V)9 Technical Characteristics

| Characteristic	Value
Transmitter Power	1 kW PEP or average RF output
Frequency Range	2 - 29.9999 MHz
Tuning Increments	0.1 kHz
Tuning Mode	Fully automatic
Frequency Stability	Not less than 1 part in 10^8 over specified temperature range
Frequency Tune Time, Transmitter	10 ms nominal, 15 ms maximum
Frequency Tune Time, Receiver	10 ms nominal, 15 ms maximum
Channels	Four 3-kHz radio channels per radio
Modes of Operation	ISB, USB or LSB, and CW
Information Types	Voice/TTY, TADIL-A Compatible
Audio System External Lines Line Signaling (ring through) Radio Signaling (ring through) Telephone	 8 each, 2- to-4-wire LB lines 8 lines, 20 or 50 Hz 8 lines, switchable to 1,600-Hz, 2,600-Hz or an FM 2,150/2,450-Hz signal shifted at a 69-Hz rate One each, TA-312/PT
VFTG Terminal Equipment	
Speech-Plus TTY	8 speech plus 8 TTY channels (85-Hz shift) at 2,805 $\pm$ 42.5 Hz
Dual TTY Terminals (2 each 8-channels)	8 channels (85 shift) VFTG channels (switchable to 4-channel diversity and split operation)
Data Circuits	All loops full duplex compatible with 60/20-mA neutral or 20-mA polar DC circuits and 1,275 $\pm$ 42.5 Hz VFTG
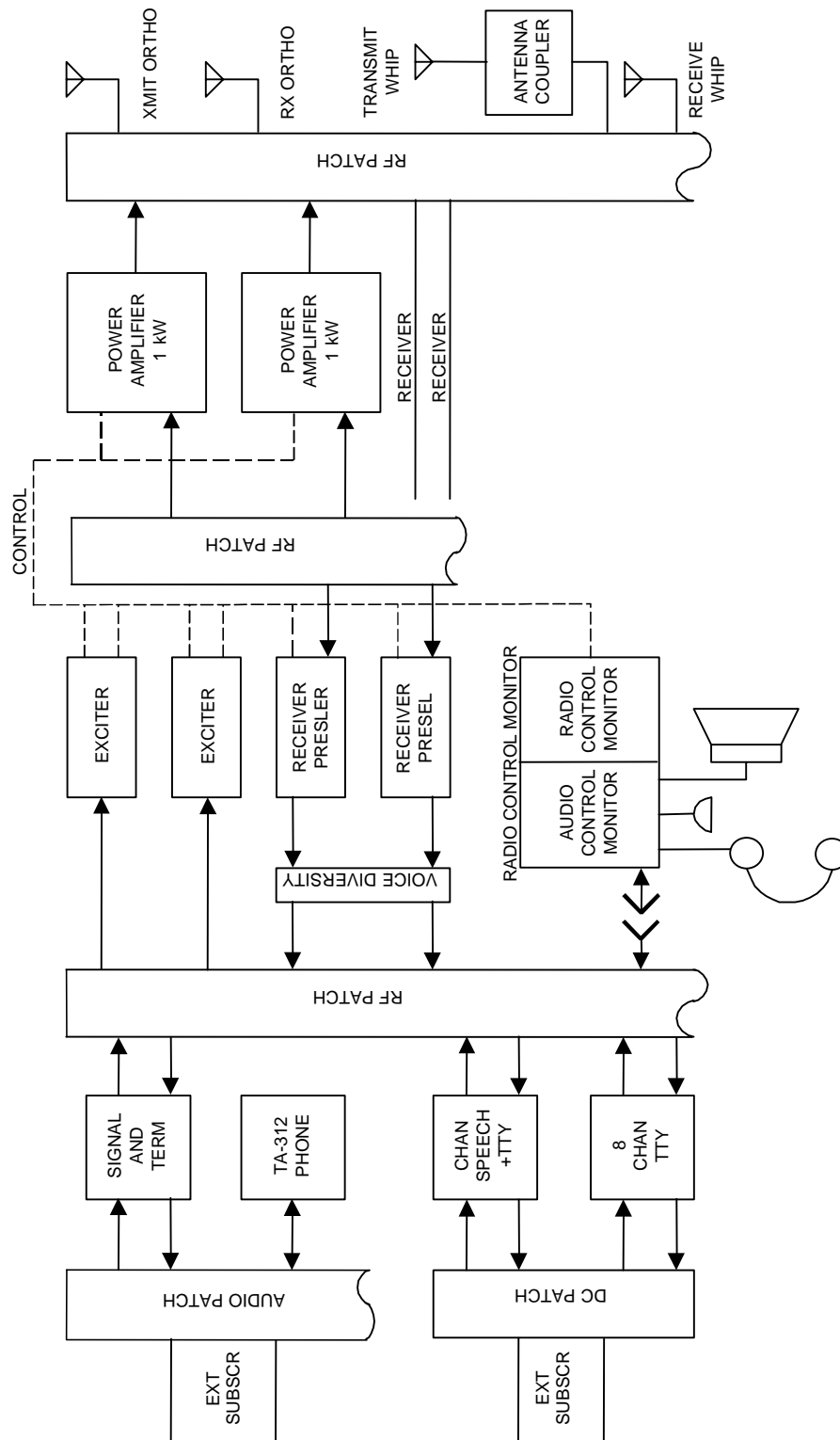
Figure G-4. AN/TSC-60(V)9 Communications Central, Simplified Block Diagram

Enclosure G

The system provides HF and tactical UHF satellite communications equipment. The AN/TSC-120 operation, including radio monitor and control, modems, and BITE, is fully automated using a standard IBM PC/AT laptop computer. The AN/TSC-120 also contains a message processing system, which also uses a standard PC to automate the message preparation and handling process.

a. Operational Description

(1) HF Radio Subsystem. The subsystem hardware (Table G-6) includes two four-channel receivers with preselectors, one automatic link establishment (ALE) module, and one four-channel exciter with a postselector. A 1-kW power amplifier and a fast-tune, 1-kW antenna-matching unit provide the necessary RF amplification. Radio control and monitoring are provided using a multifunction audio panel capable of sideband selection, microphone interface, speaker or headset selection for audio monitoring, and an independent TEMPEST-approved computer. The system can be controlled locally or remotely at distances of up to 10 miles. The subsystem has ALE and automatic link quality assessment (ALQA) IAW MIL-STD-141A for up to 100 stations and up to 100 frequencies. See Table G-7 for a listing of technical characteristics.

(2) UHF Radio Subsystem. The AN/TSC-120 can provide UHF A/G, VHF and UHF LOS, and UHF TACSAT operation. The available equipment includes one receive and transmit module, one 20-kW VHF-UHF power amplifier, and one modem card. By adding appropriate controller cards, the UHF subsystem can add MIL-STD-188-182 and MIL-STD-188-183 demand assigned multiple access (DAMA) capabilities. Radio control and monitoring are provided using the same hardware used in the HF subsystem. The subsystem can also be remoted up to 10 miles. A high-gain, quick-erect TACSAT antenna is capable of shelter or tripod mounting.

(3) Radio Telephone and Modem Subsystems

(a) The HF radio telephone and modem interfaces are provided by two signal terminal units and three MDM-2001 modems.

Table G-6. AN/TSC-120 System Components

Component	Designation
HF Subsystem	
Radio Receiver-Transmitter	RT-1644/TSC-122
RF Amplifier	AM-7425A/TSC-122
Antenna Coupler	CU-2462/TSC-122
Communications Modem	MD-1275/U
Component	Designation
Computer Control	Model 1537
Signal Terminating Unit	STU-5M
AUTODIN Terminal Unit	Model 287A-0203
SK Modem	MD-1275/U
VHF-UHF Subsystem	
Receiver-Transmitter	RT-2051
Component	Designation
HF/TACSAT Communications Modem	MDM-2501
VHF-UHF Power Amplifier	PA-2020A
UHF TACSAT Antenna	D/M SE77

Table G-7. AN/TSC-120 Technical Characteristics

Characteristic	Value
Transmitter Power	1 kW PEP or average RF output adjustable in 100 steps
Frequency Range	2 to 29.9999 MHz
Tuning Increment	100 Hz
Tuning Mode	Fully Automatic

Table G-7. (Cont'd)

Characteristic	Value
Frequency Stability	One part in 10^8/day over specified temperature range

Frequency Tune Time
     Transmitter
     Receiver
	
	 1 ms (normal)
	 1 ms (nominal)

Modes of Operation	4-channel ISB, USB, LSB, ALE, and CW/FM
ISB Information Types	Voice, data, and TTY
Remote Control	Full radio and ALE control from a 10-mile location
Telephone	Local TA-838: DTMF signaling, dialing, and ringing: 2- or 4-wire conversion; VOX keying capability.
Modem Modes	8-channel VFCT (MD-1290 equivalent). Single channel FSK (MD-522 equivalent narrowband and wideband) time diversity (MD-1142 equivalent). 16-tone programmable IAW MIL-STD-188-110A normal and enhanced. High-speed programmable (MD-1061 equivalent). Wireline and high performance (39-tone/single tone) IAW MIL-STD-188-110A.
External Teletypewriter/Data Interface	FSK, 16 channels: 16 channels; MIL-STD-188-114

Table G-7. (Cont'd)

Characteristic	Value
Internal Message I/O	AUTODIN Modes I, II, V (Category I, II, III certified)
	75 to 2,400 bps landline
	75 to 2,400 bps HF
	AN/UYK-85, AN/UGC-74/129 interoperability
	75 to 1,200 bps asynchronous
	KG-84A/C for secure traffic

(b) The telephone interfaces include two- to four-wire conversion and VOX operation compatible with the TA-312 and TA-838 and a variety of tactical switchboards.

(c) The MD-2001 modem provides a variety of high-speed multitone, single-tone, 8-channel VFCT, MD-1061, MIL-STD-188 16-tone, 39-tone, and 16-tone enhanced modem waveforms and various-speed, single-channel radio FSK TTY modes; e.g., MD-522 narrowband and wideband waveforms.

(d) The UHF TACSAT modem (MDM-2501) interface has, less the VFCT and MD-1142 modes, all the modes of the MDM-2001, plus the 1,200 and 2,400 bps satellite modes.

b. Message Processing System. This system connects to the DCS using the Mode I, II, and V DISA-certified AUTODIN Interface Unit. The system is certified to transmit and receive JANAP 128 messages at data rates up 2,400 bps in Modes I and II and 1,200 bps in Mode V. In addition, externally generated ACP-126 (Modified), DD173, and MTF

editor messages previously stored on 3.5-inch floppy disks can be recreated, renamed, edited, and transmitted.

8. <u>AN/TSC-122 Communications Central</u>. The AN/TSC-122 is a transportable 1-kW HF communications system housed in an EMP-hardened, S-250 shelter and mounted on an M-1028 CUCV or M-1097 HMMWV. The AN/TSC-122 provides the Army Special Forces with multichannel radio access to the DCS (DSN and AUTODIN) and intratheater communications between operating bases. The system will communicate with the current family of DCS Communications Centrals (AN/TSC-60(V) series). A 2,500-mile link is provided by sloping V antennas.

    a. <u>Radio Subsystem</u>. The AN/TSC-122 radio subsystem includes two four-channel receivers with preselectors capable of operating in space diversity and one four-channel exciter with a postselector. A 1-kW power amplifier and a fast-tune, 1-kW antenna matching unit provide the necessary RF amplification. Radio control and monitoring are provided using a multifunction audio panel capable of sideband selection, microphone interface, speaker or headset selection for audio monitoring, and an independent TEMPEST-approved computer. The system can be controlled locally or remotely at distances up to 10 miles. The system has ALE and ALQA IAW MIL-STD 188-141A for up to 10 stations and up to 20 frequencies. Table G-8 is a listing of AN/TSC-122 system components. Table G-9 is a listing of technical characteristics.

    b. <u>Radio Telephone and Modem Subsystems</u>. The radio telephone and modem interfaces are provided by two STU-5M signal terminating units and three MDM-2001 multimode modems. The telephone interfaces include two- or four-wire conversion and VOX operation and are compatible with the TA-312 and TA-838 and a variety of tactical switchboards.

        (1) The MDM-2001 has the capability to interoperate in 10 system modes (see Table G-9). Excluding the MD-110A mode, each modem is capable of handling two modes simultaneously. Each MDM-2001 can be programmed for a maximum of 17 possible configurations.

Table G-8. AN/TSC-122 System Components

Equipment Title	Designation
Radio Receiver-Transmitter	RT-1644/TSC-122
RF Amplifier	AM-7425/TSC-122
Antenna Coupler	CU-2462/TSC-122
Communications Modem	MD-1275/U
Computer Control	C-12154/TSC-122
AUTODIN Terminal Unit	Model 287A-0203
Signal Terminating Unit	STU-5M
FSK Modem	MD-1277/U
Antennas	One 16-foot whip Three short-long-range sloping V with receive space diversity and NVIS.

(2) The AN/TSC-122 can be operated in the clear and secure voice and data modes. The system uses KY-65A and KG-84A or KG-84C COMSEC equipment.

c. Message Processing System. Message and data entry storage and printing are accomplished using a TEMPEST approved printer and laptop computer. The AN/TSC-122 message processing system connects to the AUTODIN using a DISA certified AUTODIN interface unit. The system is certified to transmit and receive JANAP 128 messages at data rates up to 2,400 bps in Mode I and 1,200 bps in Modes II and V. Externally generated ACP-126 (modified), DD147, and MTF editor messages, previously stored on a 3.5-inch floppy disk, can be recreated, renamed, edited, and transmitted.

Table G-9. AN/TSC-122 Technical Characteristics

Characteristic	Value
Transmitter Power	1 kW PEP or average RF output adjustable in 256 steps
Frequency Range	2 to 29.9999 MHz
Tuning Increment	100 Hz
Tuning Mode	Fully Automatic
Frequency Stability	One part in 10^8 /day over specified temperature range

Frequency Tune Time
 	
    Transmitter
 	
    Receiver
	
	1 ms (exciter normal)
	
	1 ms (nominal)

Modes of Operation	4-channel ISB, USB, LSB, AME, and CW/FM
ISB Information Types	Voice, data, and TTY
Remote Control	Full radio and ALE control from a 10-mile location
Telephone	Local TA-838
Modem Modes	8-channel VFCT (MD-1290 equivalent) Single channel FSK (MD-522 equivalent narrowband and wideband) Time diversity (MD-1142 equivalent) 16-tone programmable IAW MIL-STD-188 normal and enhanced High-speed programmable MD-1061 equivalent) Wireline and high-performance (39-tone/single tone IAW) MIL-STD-188-110, CH 2
External Teletypewriter/Data Interface	20/60-mA loop, 10 channels; programmable FSK, 16 channels; MIL-STD-188-114

Table G-9. (Cont'd)

Characteristic	Value
Internal Message I/O	AUTODIN Modes I, II, V (Category I, II,III certified)
	75 to 2,400 bps landline
	75 to 2,400 bps HF
	AN/UGC-74/129 interoperability
	75 to 1,200 bps asynchronous
	KG-84A/C for secure traffic

9. <u>AN/TSC-95 HF Communications System</u>. The AN/TSC-95 consists of a record traffic terminal subsystem (AN/TGC-46) and an HF radio Subsystem (AN/TRC-171).

   a. <u>Functional Description</u>. The AN/TSC-95 system provides for reliable single sideband radio-teletype or voice communications with a designed, designated NAVCOMSTA. CW transmission and reception type communications are also available. The system has been designed with maximum patching flexibility and can be operated in various modes, thus permitting the selection of the most advantageous mode for each tactical deployment. The system has three basic modes of operation: FSK, voice frequency carrier teletype (VFCT), or voice. These three basic modes provide the seven operating mode options that may be employed separately or in combination as listed in Table G-10.

   b. <u>AN/TRC-171</u>. The AN/TRC-171 HF radio subsystem consists of an S-280 shelter containing Navy standard shipboard HF radio equipment, accessories, and antennas. This subsystem can operate independent of, or remote from, the AN/TGC-46 through the standard 26-pair assault cable or the external control feed-through panel.

Table G-10. AN/TSC-95 Basic Operating Modes

Option	Communications	Signal	Modulation	RF Used
1	2-channel secure TTY FDX	VFCT	USB	SF each direction
2	2-channel secure TTY FDX	VFCT	USB	Two frequencies each direction
3	1-channel secure TTY FDX	FSK	USB	Single frequency each direction
4	1-channel secure TTY FDX	FSK	USB	Two frequencies each direction
5	1-channel secure TTY FDX and 1-channel nonsecure voice FDX	FSK	ISB and voice	Single frequency each direction
6	1-channel nonsecure voice HDX	Voice	USB	Single frequency (push-to-talk)
7	1-channel nonsecure CW HDX	CW	AM	Single frequency each direction

   c. AN/TGC-46. The AN/TGC-46 Record Traffic Terminal consists of an S-280 shelter containing an assemblage of standard Model 28 TTY equipment, modems, patch panels, and space for COMSEC equipment for the operation of two full-duplex teletype circuits. This system can operate independent of, or remote from, the AN/TRC-171 radio subsystem through standard 26-pair assault cable or control feed. Figure G-5 depicts message traffic flow to the DCS.

10. AN/TSC-118 HF Communications System. The AN/TSC-118 is a transportable communications command and control center housed in a modified S-280 C/G shelter. The AN/TSC-118 provides secure and nonsecure voice or data communications in the HF, VHF, UHF, and UHF satellite bandwidths. Equipment provided in the system is listed in Table G-11.
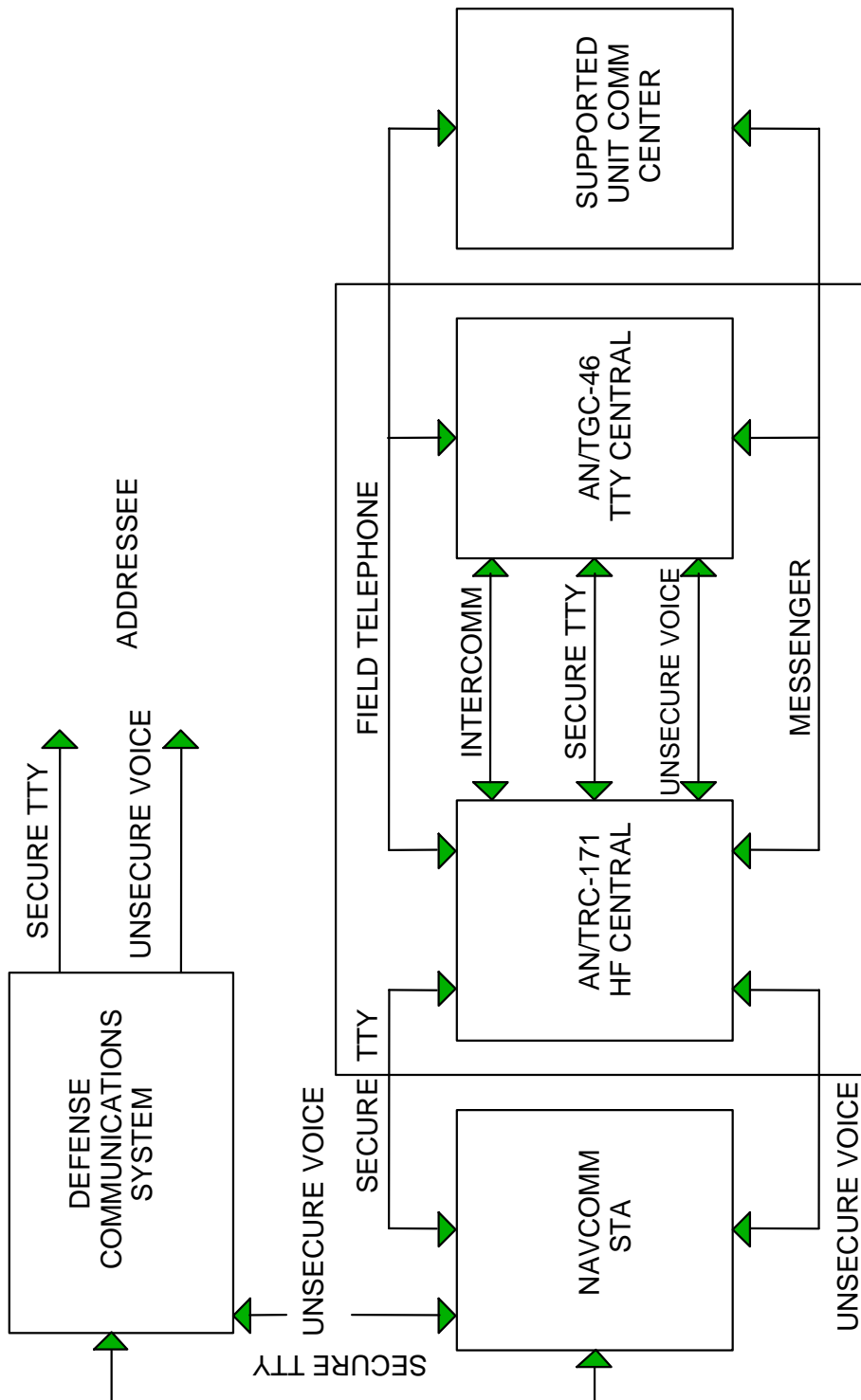
Figure G-5. Message Traffic Flow, AN/TSC-95 Communications System

Enclosure G

Table G-11. AN/TSC-118 Equipment

Equipment	Quantity
T-1453, HF Transmitter	3
AM-7144, 10-kW Power Amplifier	1
AM-7163, 1-kW Power Amplifier	2
R-2222, HF Receiver	3
AN/ARC-164, UHF Transceiver	1
RT-1300, VHF Transceiver	2
AN/WSC-3(V)9, SATCOM Transceiver	1
Codex MX-2400, Digital Data Modem	2
MD-1187, Digital Data Modem	2
MD-1186, Telegraph Modem (1 CH)	2
MD-1185, Telegraph Modem (16 CH)	2
SB-3614, 30 Channel Switchboard	1
AN/UGC-74A, TTY Terminal	2
KG-84C, GPEE	2

a. Functional Description. The AN/TSC-118 contains three HF radio systems. Each radio is capable of processing four channels (3-kHz bandwidth) in either simplex or duplex mode. Two radios are configured for operation with 1-kW power amplifiers using whip antennas. The third system operates with a 10-kW amplifier using two sloping V antennas (separate transmit and receive). The VHF radio system consists of two RT-1300/ARC-186(V) transceivers. One is operated as an AM system and the other as an FM system. An AN/ARC-164(V)5 provides UHF amplitude modulated communications. UHF satellite communications are provided by an AN/WSC-3(V)9 transceiver. An SB-3614(V)/TT tactical telephone switchboard provides a 30-line switch capability to interface telephones to the radio system. Technical characteristics of the AN/TSC-118 are provided in Table G-12.

b. Interfaces. Eight STU-5Ms are provided for two- to four-wire voice and signaling conversion. In addition to voice communications, several modems are provided to interface data and teletype communications to the terminal (see Table G-11). Two AN/UGC-74(V)3 Communications Terminals are provided for operator TTY interface.

Table G-12. AN/TSC-118 Technical Characteristics

Characteristic	Value
High-Power HF Radio Group	
Frequency Range	2-30 MHz
Power Output	10 kW PEP
Channel Spacing	100 Hz
Low-Power HF Radio Group	
Frequency Range	2-30 MHz
Power Output	1 kW
Channel Spacing	100 Hz
UHF Radio System	
Frequency Range	225-399.975 MHz
Power Output	30/100 W (FM/FSK)
Channel Spacing	25 kHz
VHF Radio System	
AM Transmit/Receive Frequency	116-151.975 MHz
AM Receive only Frequency	108-115.975 MHz
FM Transmit/Receive Frequency	30-87.975 MHz
Channel Spacing	25 kHz
Power Output	10 W (minimum)
SATCOM Radio System	
Frequency Range	225-400 MHz
Channels	7,000 in 25-kHz increments
Emissions	NB AM, WB AM, FM, FSK, PSK
Power Output	30 W AM, 100 W FM

11. Automatic Link Establishment Tutorial

  a Introduction. The purpose of ALE is to automatically select an optimum HF communications channel out of an available list of preprogrammed channels and execute a handshaking protocol to automatically connect two or more HF radio systems in a communications link with minimal operator involvement. There are two standards for ALE. The civil government standard (FED-STD-1045) is identical to and interoperable with the MIL-STD-188-141A version, but the MIL-STD version incorporates additional features that are not in the civil standard. The following information is based on implementation of ALE by Collins in the AN/TSC-120 and AN/TSC-122 terminals.

b. Sequence of Operation for Scanning and Receiving ALE Calls

(1) The system is turned on and operating with the appropriate list(s) of channels, ALE addresses, system parameters, and other programmable presets and parameters required to configure the system for operation. System setup information of this type is normally provided by the network manager in the form of datafill files.

(2) The system should be operating in the ALE SCANNING mode. The SCAN mode may be selected from the ALE main menu.

(3) The operator may return to the system main menu and continue with other system functions as required. The ALE system will continue to scan the HF receiver through the currently selected scan list of programmed channels listening for sounds or calls from other ALE stations. If an HF ALE call is received while the System Main Menu is being displayed, the pertinent information regarding the call will be displayed to the operator in the appropriate window of that menu.

(a) If the scanning ALE system receives a call that is addressed to the operator's station (per the preprogrammed call sign), the system will automatically stop scanning and transmit a response on the incoming receive frequency. If the other station hears the call, it will transmit an acknowledgment and the three-step handshake (data exchange) will be completed. A message will be displayed to the operator indicating that the ALE system is now ready to communicate with the calling station. The channel number, frequency, and radio mode, along with the calling station's address, will also be displayed to the operator. Receive audio output from the radio will automatically be enabled so the operator can hear the caller's transmission.

(b) The ALE system uses available link quality analysis (LQA) data to maximize the probability of successful link establishment on the first calling channel tried. However, if the calling station did not hear the called station's automatic response, it will not transmit an acknowledgment, but will repeat the call on another channel. The calling station will automatically resume scanning if no acknowledgment is received and will be ready to receive another call or sound. The handshake process will be repeated in its entirety for each new call

attempt until a usable channel is found, all programmed channels have been unsuccessfully tried, or the max call attempts limit (1 to 99, Default = 10) has been reached, whichever occurs first.

(4) Once the READY indication is given, the link has been established and communications may begin. Communications may be by normal push-to-talk (PTT) voice or data means. Once the communications link has been established, the ALE system has no further involvement until communications have been completed. The calling station may continue communications on that channel for as long as desired. However, each of the linked stations must transmit periodically to avoid automatically timing out and returning to scan. NOTE: The operator who initiated the call should also be the first to initiate communications once the link is established. When a call is received, the operator should not press the PTT key or manually initiate a data transmission until the caller has completed the first transmission. If no communication is heard, allow the system to time out and automatically return to scan without ever keying the system.

(5) Once communications have been completed, or if no local transmit activity had been initiated for a predetermined period of time, the system will automatically terminate the link and resume scanning. The operator may manually terminate the link before the automatic time-out by selecting the SCAN mode through the ALE main menu.

(6) If the channel fades out or otherwise becomes unusable after the link has been established, the ALE system WILL NOT compensate. The operator must initiate a new call to reestablish contact

(a) Before attempting to reestablish the link, both station must return to the scanning mode. Operators can return to the scanning mode by (1) doing nothing and allowing the systems to time out automatically return to the scanning mode or (2) manually selecting the SCAN mode through the ALE main menu.

(b) To preclude missed contacts when both stations have simultaneously attempted to transmit calls to each other, the operator who originally initiated the call is responsible for initiating a callback. The operator who was not the originator of the link that was lost, should not attempt to call the other station back. If unsure a link is down,

return the system to the scanning mode and wait patiently for a callback from the originating station.

   c. <u>Sequence of Operation for Initiation ALE Calls</u>

      (1) The system is turned on and is scanning the appropriate scan list of programmed channels according to the datafill provided by the network manager.

      (2) The address of the station to be called is entered through the ALE main menu.

      (3) The calling process is initiated by executing the CALL function from the ALE main menu or by momentarily pressing the PTT key.

      (4) The READY indication will signal that a communications link has been established with the called station, or the operator may manually return the system to the SCAN mode from the ALE main menu screen to abort the calling process at any time.

      (5) Once the READY indication is given, the called station can talk to the calling station through normal PTT voice or data means. The calling operator talks (or transmits data) first since that station placed the call. Once the channel communications have been established, the ALE system has no further involvement until communications have been completed. Communications may continue on that channel for as long as desired. However, each of the linked stations must transmit periodically to avoid automatically timing out and returning to scan (10 to 1,000 seconds, default = 60 seconds).

      (6) Once communications have been completed, or if no local transmit activity has been initiated for a predetermined period of time, the system will automatically terminate the link and resume scanning. The operator may manually terminate the link before automatic time-out by selecting the SCAN mode.

      (7) If the channel fades out or otherwise becomes unusable after the link has been established, the ALE system WILL NOT compensate. The operator must initiate a new call to reestablish contact. Both stations must be back in the scanning mode before attempting to

reestablish the link. Operators can do nothing and allow the systems to time out and return to the scanning mode automatically or manually send them back to scan. A simple procedural convention, making initiation of the callback the responsibility of the station that originally initiated the call, will preclude missed contact when both stations simultaneously transmit calls to each other.

(8) Stations are assigned one or more addresses, which are alphanumeric call signs that can be used by the ALE's computers. To call another ALE station, the call sign must be known. The preassigned call signs stored in the system may be displayed through the LIST function on the ALE main menu or via the COMMAND LINE expert mode. A three-character address has been found to be the most time efficient address configuration, although addresses from 1-15 characters in length are allowed. Note, however, that single character addresses are not accessible through the touchscreen display and, if used, will have to be entered through the keyboard using the COMMAND LINE expert mode.

(9) Automatic communication links may be established using any one of five types of ALE calls: individual calls, group calls, net calls, any calls, and all calls.

(10) The ALE system is also capable of sending and receiving short text messages embedded in the ALE signaling protocols. These short messages are called automatic message displays (AMD) and are accessible through the COMMAND LINE function from the ALE main menu. Ten message buffers are provided for sending and receiving messages with each message containing up to 90 characters. Any 9 of the 10 message buffers may be programmed with transmit messages. Any of the 10 message buffers not programmed with transmit messages will automatically be available for storing received messages. Received messages are time tagged, stored, and displayed to the operator. When all available receive buffers have been used, any new message received will overwrite the oldest received message currently in storage. All 10 message buffers may be queued and reviewed by the operator at any time. AMD messages may be composed, entered, edited, and sent from the display terminal. Received AMD messages may also be retransmitted.

12. <u>DCS HF Gateway Entry</u>. DISA CONEXPLAN 10-98 outlines the capabilities and scheduling, facilities, and operations for HF entry, Annexes I and J, respectively. Brief extracts are summarized below:

   a. <u>DCS HF Entry Stations</u>

      (1) Andrews AFB, MD.

      (2) MacDill AFB, FL.

      (3) Norfolk, VA.

      (4) Stockton, CA.

   b. <u>Capabilities</u>. The following are the DCS HF/ISB radio current entry capabilities, unless otherwise indicated in Appendixes 1 to 11, Annex I, DISA CONEXPLAN 10-98:

      (1) Termination of one or two multichannel HF/ISB radio systems, either of which may be activated for 6KOOB9W (two-channel) or 12KOOA9B (four-channel) transmission mode. Q and Z operating signals will be used in accordance with ACP 131, Operating Instructions.

      (2) Termination of one 8-channel or one 16-channel VFCT system.

      (3) Voice patch to DSN through local switchboard appearance or circuit extension. HF voice operations involve switchboard access with operator assistance at DCS entry and tactical sites. AN/FTA-28 or AN/FTA-15 compatible terminal equipment (1,600-Hz signaling) is required to effect the DCS interface. Input from the switchboard to the AN/FTA-28 will typically be 20 Hz, 90V signaling.

      (4) A 75-baud termination with manual refile into the AUTODIN network.

      (5) Variable quantities of DCS channel resources to support onward extension of special-purpose voice and teletype circuits.

      (6) GENSER-only, 300-baud, MODE I AUTODIN entry.

c. Tasks and Responsibilities

(1) The DISA Contingency Operations Branch (DISA/D333) is responsible for planning and arranging contingency and exercise DCS HF entry within the Western Hemisphere and coordination with DISA areas for contingency HF entry worldwide. In addition, it identifies requirements or supplemental communications tail segments extended from the DCS entry station that must be established through leased commercial service.

(2) The combatant commands, Service components, and other DOD agencies and activities having Western Hemisphere HF entry are responsible for using CONEXPLAN 10-98 to plan HF entry.

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ENCLOSURE H

STANDARDIZED TACTICAL ENTRY POINT (STEP)

1. Introduction. STEP is a Joint Staff-directed upgrade to the DSCS Digital Communications Satellite Subsystem (DCSS) program to improve and standardize tactical warfighter access to strategic DISN networks. STEP will improve the Army, Navy, Air Force, Marine Corps and Special Operations access to command and control services including Defense Switch Network (DSN) and Defense Red Switch Network (DRSN) for voice; the unclassified-but-sensitive internet protocol router network (NIPRNET), SECRET internet protocol router network (SIPRNET) and the Joint Worldwide Intelligence Communications System (JWICS) for data and special user video; and video teleconferencing (VTC) for common user video.

   a. The STEP upgrade program is coordinating with other programs that affect warfighter access to the DISN including Integrated Tactical-to-Strategic Data Networking (ITSDN), heavy terminal/medium terminal (HT/MT) modernization and AN/GSC-52 modernization, automated digital multiplexing system (ADMS), and the DSCS integrated digital network exchange (IDNX) installation. The ADMS, previously designated the Navy Tactical Network (NAVTACNET), will support Navy-unique and joint tactical C4I data requirements. A deployed tactical unit's primary means of accessing strategic services is by using SHF SATCOM at X-Band over DSCS into an entry point. These entry points are sometimes called DCS entry points, ground mobile forces (GMF) gateways or DISN gateways. For consistency, only the terms entry point or STEP are used in this enclosure. The TRI-TAC access to gateways is usually provided by GMF TACSAT terminals with collocated tactical circuit switches, such as the AN/TTC-39 and AN/TTC-42. This short-term access is used mostly during operations, exercises, contingencies, and relief efforts. Limited tactical-to-tactical connectivity is currently provided and the STEP program is designed to enhance that connectivity.

   b. Navy ship access to STEP can be used for day-to-day operations and can provide access to both the Navy's ADMS and the rest of the DISN for core, theater and Navy-unique C4I services. As part of ADMS, approximately 30 ships are equipped with TIMEPLEX Link 2+ and/or AN/FCC-100(V)7 low-speed time division multiplexers (LSTDMs). (See Enclosure B.) The number of ships with access to STEP sites may

expand to over 150 as AN/WSC-6 SATCOM terminal variants are installed on additional ship classes. The Navy plans to regularly use four primary STEP sites (Northwest (NCTAMS LANT), Wahiawa (NCTAMS PAC), Lago di Patria (NCTAMS EURCENT) and Bahrain (NCTS)), of which three are existing Naval Computer and Telecommunications Area Master Stations (NCTAMS) and one is a Naval Computer and Telecommunications Station (NCTS), to support continuous fleet requirements. Another six sites (Fort Buckner, Fort Detrick, Camp Roberts, Fort Belvoir, Landstuhl, and Croughton) will serve as secondary/alternate sites for increased maritime support, restoral and/or contingency service. The Navy-operated STEP sites provide both ship-to-shore and ship-to-ship communications consisting of operational and administrative traffic.

   c. STEP is an upgrade to 15 DSCS sites worldwide that will improve tactical access to strategic DISN networks by procuring and installing new equipment at entry points and by pre-positioning joint voice and data networks (JVDN). This approach will allow tactical units to quickly connect to voice and data networks for access to the DISN and to the sustaining base services that the tactical units require. Figure H-1 shows a notional JTF accessing strategic networks via STEP and terrestrial transmission. The tactical SATCOM user will typically access STEP via DSCS. Multiple STEP sites are required to support a MRC JTF requirement for strategic DISN connectivity.

   d. The pre-positioned DISN networks planned for each entry point are DSN, DRSN, NIPRNET, SIPRNET, JWICS, and VTC. The Navy will provision its own connectivity for day-to-day operations using the ADMS. The primary STEP goal is to provide the JTF immediate DISN access, which is made possible by installing sufficient equipment and pre-positioned communications services. These services are sized to meet the minimum initial JTF requirements. The equipment is capable of providing additional capacity in order to meet surge requirements. To support the surge and extended missions, non-pre-positioned circuits and/or leases will be activated based on user requirements.
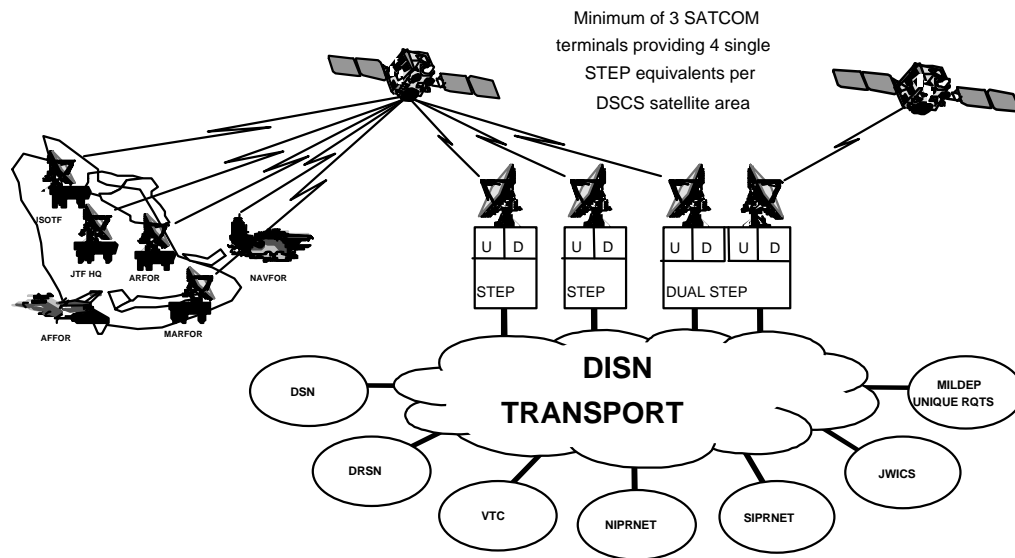
Figure H-1. Notional Joint Task Force

2. STEP Sites

a. There are a total of 15 operational STEP sites. Additionally, Fort Gordon and Fort Monmouth are being equipped with selected equipment for training and testing. The Navy does not have requirements at all STEP sites. The Navy will equip 10 of the 15 sites for ship access support and will equip Fort Gordon for training. Figure H-2 shows the worldwide distribution of single and dual STEP sites. A single STEP site supports an earth terminal that views one DSCS satellite. A dual STEP site with a collocated auxiliary satellite control terminal (ASCT) can support two or more earth terminals accessing two or more DSCS satellites. The dual STEPs have roughly twice the equipment and pre-positioned DISN network connectivity of a single STEP. ASCTs are normally used for reserve satellite control purposes, but can support STEP missions. Table H-1 lists the STEP operational sites with the type of satellite terminal and the satellite areas supported, together with status information on related programs.
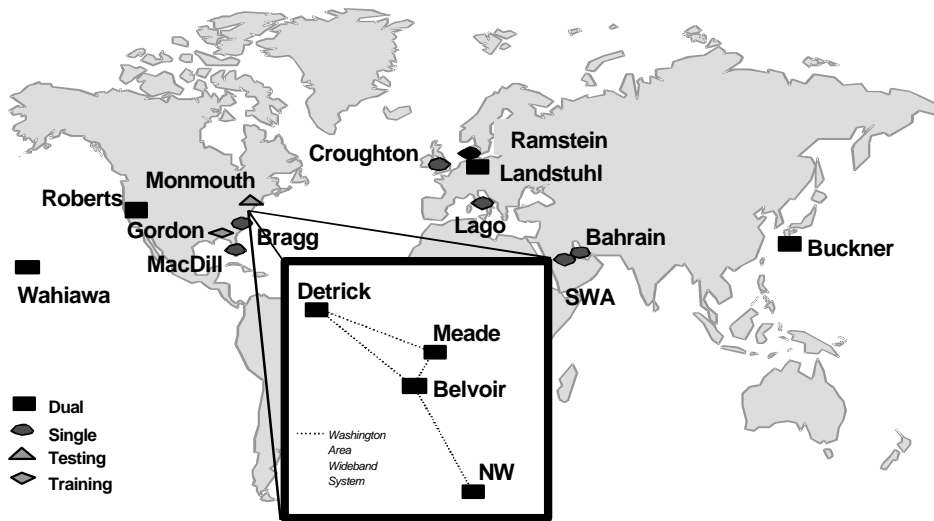
Figure H-2. Worldwide STEP Locations

b. <u>STEP Usage</u>. Each STEP site is a joint asset under the operational control of the Joint Chiefs of Staff. STEP equipment is available to all CINCs and Services on a priority basis. STEP access is managed by DISA in cooperation with the fleet commander in chief (FLTCINC), for Navy access. The Military Departments (Army, Air Force and Navy) in charge of each site are responsible for site operations and maintenance (O&M) activities. Although the initial STEP design is primarily concerned with minimum initial JTF requirements, it is flexible enough to meet additional requirements. For example, the STEP design can support multiple contingencies, multiple CINCs, multiple ship accesses and exercises simultaneously.

(1) STEP upgrades are occurring at sites equipped with earth terminals that have large antennas. These sites will support spoke-to-spoke links and can also operate as hubs, allowing efficient use of satellite power. For small deployments, keeping the hub terminal along with its switch out of the OAR will help improve the survivability of the communications connectivity.

Table H-1. STEP Sites and Related Programs

STEP SITE	STEP DATE	TERMINAL TYPE	SATELLITE AREA	ITSDN	NAVY	IDNX DATE
LANDSTUHL	COMPLETE COMPLETE	39 78 52(ASCT)	IO WA RESERVE	COMPLETE	COMPLETE NO	COMPLETE
NORTHWEST (NCTAMS LANT)	COMPLETE FY 00	52 78	WA EA	COMPLETE	COMPLETE YES	COMPLETE
FORT BUCKNER	FY 00 FY 00	39 39 52(ASCT)	IO WP RESERVE	COMPLETE	NO YES	COMPLETE
FORT DETRICK	COMPLETE COMPLETE	78 78 52(ASCT)	EP WA RESERVE	COMPLETE	COMPLETE NO	COMPLETE
WAHIAWA (NCTAMS PAC)	COMPLETE COMPLETE	78 78	WP EP	COMPLETE	COMPLETE YES	COMPLETE
CROUGHTON	COMPLETE	78	EA	COMPLETE	COMPLETE	COMPLETE
FORT BRAGG	COMPLETE	39	EA	COMPLETE	NO	COMPLETE
MACDILL	COMPLETE	39	EA	COMPLETE	NO	COMPLETE
CAMP ROBERTS	FY 00 FY 00	52 78 52(ASCT)	EP WP RESERVE	COMPLETE	YES NO	N/A GOING DIRECTLY TO MIDAS
FORT BELVOIR	FY 00 FY 00	52 52 52	WA EP EA	COMPLETE	NO NO YES	COMPLETE
SOUTHWEST ASIA (SWA)	FY 00	52	EA	TBD	NO	COMPLETE
BAHRAIN (NCTS)	FY 00 FY 00	52 52	IO EA	COMPLETE	YES YES	COMPLETE
RAMSTEIN	COMPLETE	52	EA	COMPLETE	NO	COMPLETE
FORT MEADE	FY 00 FY 00	78 78 52(ASCT)	EP EA RESERVE	COMPLETE	NO NO	COMPLETE
LAGO DI PATRIA (NCTAMS EURCENT)	FY 00 FY 00	39 52	EA IO	COMPLETE	YES YES	COMPLETE

NOTES: For information about the SMU installation, see paragraph 3f and for information
         about the MIDAS upgrade, see paragraph 4a.

    ITSDN = ITSDN routers and Key Generators (KGs) are collocated with STEP
     NAVY = NAVY procured equipment to be installed at site
      YES = Scheduled
       NO = Not currently scheduled

(2) The STEP design calls for a minimum of three STEPs to be located in each of five DSCS satellite areas, providing support to the warfighters no matter where they deploy. STEPs are primarily designed to provide JTF and force element commanders access to DISN. One STEP has the capability to provide DISN access to five of the six force elements (CJTF, AFFOR, ARFOR, NAVFOR, MARFOR, and JSOTF). However, it is unlikely that all five force elements will be loaded on the same STEP site. Large JTFs will be supported over several STEP sites and over multiple satellites depending on the deployment location.

(3) STEP will support warfighting forces and supporting organizations deploying in all phases of a crisis. The CJTF and force element commanders will have immediate access (within 24 hours) to critical circuits from any location in the world. Access to DISN via STEP will provide the capability to rapidly extend services from any DOD location supported by DISN into the theater of operation.

3. STEP Equipment Description and Operation

   a. STEP is functionally defined as all equipment, racks and cabling at the entry point from the up-downconverters and modems, through the multiplexers and other baseband equipment, including the connection to the main distribution frame (MDF). Cross-connecting at the MDF or the intermediate distribution frame (IDF) will provide the circuit path to the DSCS IDNX, allowing access to DISN services. Figure H-3 shows a typical configuration of equipment at a single STEP site. A dual STEP site will have approximately twice the equipment and capabilities as a single STEP site.

   b. STEP equipment is intended to support joint access to strategic DISN services. At dual sites, operators can patch multiplexers, modem and switch equipment from one antenna to another, allowing most of the STEP equipment at the site to be used on either satellite. Upconverters and downconverters are usually dedicated to a designated antenna and cannot be patched between antennas. Conflicts in STEP equipment allocation among the tactical units services will be resolved by the OCJS approval, validation and prioritization process.

   c. Navy Equipment. To meet unique shipboard operating requirements and to take advantage of available commercial-off-the-shelf (COTS) technology, the Navy will continue to deploy their own equipment
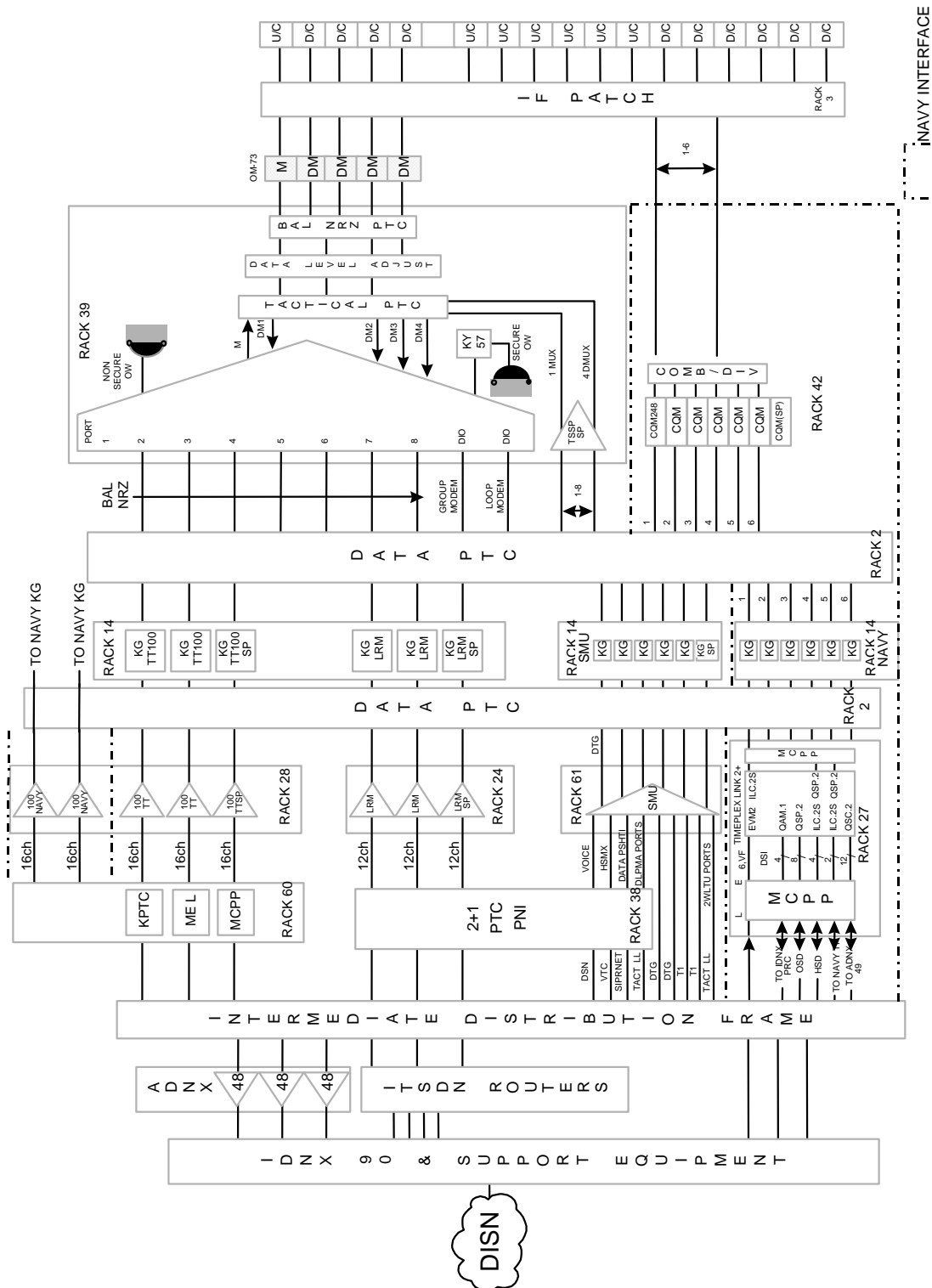
Figure H-3. Single STEP Site Typical Configuration

suite, including the TIMEPLEX multiplexer and COTS modems compliant with the DCSS OM-73 modem standard. (see Appendix B to Enclosure B). This equipment is being installed and configured as part of STEP, but is being procured by the Navy. Network management and funding for DISN transport of the ADMS network is also provided by the Navy. The FLTCINCs or their designated representatives will exercise control of the ADMS within their AOR. Figure H-4 shows the Navy's initial operational capability (IOC) configuration for a single suite of equipment.

d. <u>Frequency Converters</u>. The up- and downconverters are associated with the earth terminal and provide the conversion between the IF (commonly 70 MHz) and SHF frequencies. Under STEP, seven upconverters and ten downconverters are being installed at single sites and double that number at dual sites, as rack capacity allows. At dual sites, converters from one antenna cannot be patched to the other antenna. The DSCS converters are shared joint assets and are assigned to Navy and GMF TRI-TAC units as priorities dictate. At most sites the HT/MT Modernization is required before the STEP converters are installed. The HT/MT Modernization Program provides a maximum converter capacity per antenna of 24 upconverters and 32 downconverters. At some sites, the number of converters required for simultaneous tactical, strategic, and contingency use will exceed this maximum capability. The shortfall in the number of converters is exacerbated by the inability of the HT/MT converters to support Naval agile-IF operations in excess of 256 Kbps. The use of multiple modems into a single converter is no longer considered a standard configuration. However, Naval contingency requirements will be met within the technical bounds of the converters until more converters are available.

e. <u>Modems</u>. Modems provide the conversion between baseband data and IF. The STEP modems for TRI-TAC support are OM-73s. The modems currently being added by the Navy are OM-73 compliant COTS modems such as the COMQUEST CQM-248As. On the DSCS satellite, it is DISA policy and the Navy's goal that only one modem be used with one converter.
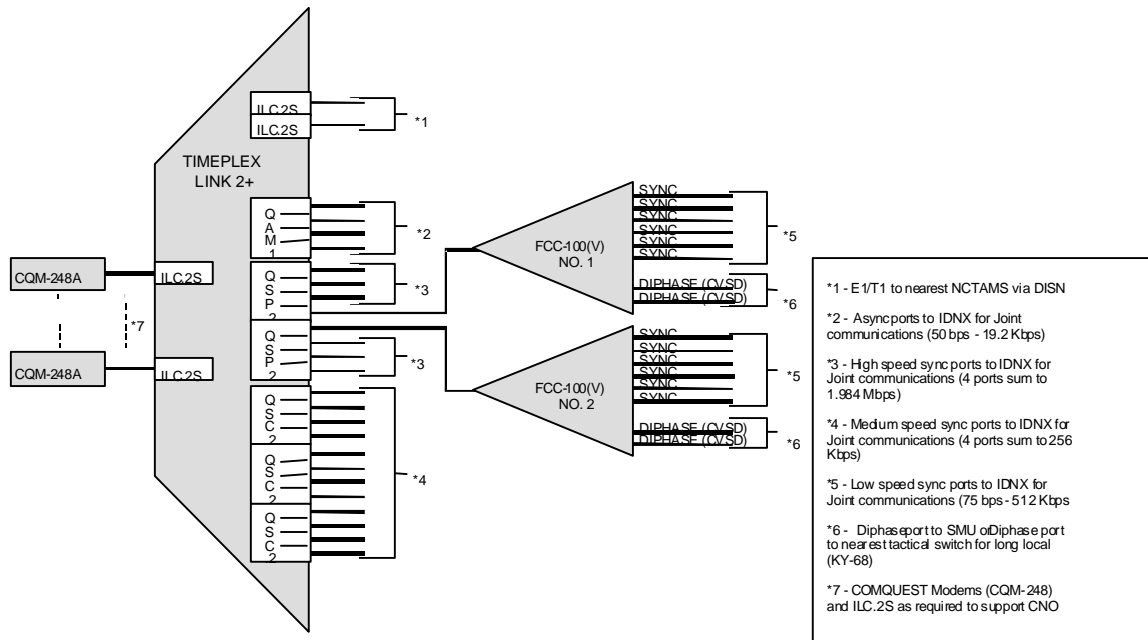
Figure H-4. Navy's Initial Operational Capability Configuration

    f. <u>Circuit Switch</u>. The switch multiplexer unit (SMU) 96 is a flood
search equipped tactical circuit switch with some data capability. The
SMU is a compact version of the vanized AN/TTC-39A(V)4 tactical circuit
switch and supports 748 external lines. It contains circuit cards and
software similar to the big switches, but is 13 inches high and rack-
mounted. The SMU also comes with a laptop computer for the operator
interface, and a digital nonsecure voice terminal (DNVT) may be
connected to the switch for coordination purposes. Because there is no
known requirement for the call service position console (CSPC), the CSPC
equipment will not be provided. See CJCSM 6231.02A Chapter II-F, for
further explanation of the SMU. The COMSEC suite (HGX-93) with loop
key generators will be provided. The SMU has been added to all STEP
sites with the following exceptions, installation completion as indicated:
SWA, 06/01; Bahrain, 05/00, Ft Belvoir, 10/00; and Ft Meade, 12/00.
Secure calls are possible when a STU-III is used on both ends of the link.
When tandeming calls between tactical switches via the STEP SMU, both
secure and nonsecure are supported. See CJCSM 6231.05A for further
explanation of COMSEC procedures. The SMU will improve the tactical
voice interface to DSN, tandem calls between tactical switches, provide a
user encrypted 64-Kbps Army tactical packet network (TPN) access to

SIPRNET, and provide a circuit up to 512 Kbps bandwidth for VTC or another data application.

g. <u>SMU Configurations</u>. Four SMU 96 configurations are available: redundant COMSEC capable (R/C); nonredundant COMSEC capable (NR/C); redundant not COMSEC capable (R/NC); or nonredundant not COMSEC capable (NR/NC). Table H-2 indicates the external interfaces supported by each SMU configuration type. STEP is installing one Configuration 2 (C2) SMU 96 at each site.

Table H-2. External Interface Capability by SMU Configuration

SMU CONFIGURATION	EXTERNAL INTERFACE CAPABILITIES		
	CDI (DTGs)	NRZ (DTGs)	T1/DTG CARDS
C1 R/C	9	9	5
C2 NR/C	11	9	6
C3 R/NC	9	9	6
C4 NR/NC	11	12	6

h. <u>SMU Operation</u>. The primary function of the STEP SMU is to provide a DSN interface for tactical DTGs from the deployed tactical circuit switches (AN/TTC-39, AN/TTC-42, SMU or CV-4180 LTU). The SMU then breaks down the DTGs into analog or PCM channels for voice and digital channels for data. Each SMU will be configured to support a minimum of seven external DTGs and 48 voice channels (2 T1s) to DSN. If required, two of the DTGs will be used in a terrestrial ring to interconnect the STEP SMU supporting the JTF. Normal operations dictate that all DTGs be available for training missions and exercises. This ring concept allows alternate routing and relieves congestion problems. Each SMU will also support up to two 64-Kbps switchable circuits (PSHTI card applications) which has been identified as a special requirement for Army TPN to SIPRNET connectivity. The Army TPN connection to SIPRNET via the SMU PSHTI card requires COMSEC-link encryption at the deployed Army switch. Each SMU 96 has a multiplexer/demultiplexer (MUX/DEMUX) card that allows one data circuit at 128, 256 or 512 Kbps to tunnel through the circuit switch transmission network. Each SMU has four four-port Diphase Loop Modem Adapter (DLPMA) cards that allow loops to be extended to tactical

phones on Navy ships. The SMU is planned to have a tactical area code to allow for tandeming.

(1) The STEP SMU provides the following tandem phone capabilities:

(a) Tandems DSVT calls in the secure mode.

(b) Tandems STU-III calls into DSN and from deployed to deployed.

(c) Tandems DNVT non-secure calls into DSN and from deployed to deployed. DNVT calls tandeming through the STEP SMU will receive the nonsecure warning tone alerting the user that the STEP SMU is not in a protected distribution system and that only nonsecure traffic should be passed.

(2) The STEP SMU provides the following loop phone capabilities:

(a) Supports up to 16 DSVT or DNVT long locals. Because the SMU has no COMSEC suite, long local DSVT calls in the secure mode are not supported.

(b) Provides eight loops for analog two-wire phones such as STU-III. These loops are planned to be extended by the AN/FCC-100 to the deployed units.

(3) The STEP SMU provides the following trunk capabilities:

(a) Supports up to four T1s into DSN or, if required, toward the deployed area.

(b) Supports up to seven external DTGs. Five are planned for the deployed area. Two are planned to connect to other STEP SMUs in the SMU ring during major contingencies.

(4) The maintenance concept envisioned for the SMU is to the lowest replaceable unit (LRU); i.e., to the card level.

(5) Network management of the SMU will be done by the DISA regional control centers (RCCs) using the Automated DSN Integrated

Management Support System (ADIMSS). The SMU is being equipped with a SNMP agent that provides a standards based interface compatible with integrated network management system (INMS) and joint Defense Information Infrastructure (DII) control system deployed (JDIICS-D). (See CJCSM 6231.07B.)

    (6) For detailed SMU card population, refer to Table H-9.

    i. <u>Multiplexers</u>. Three multiplexer types are being added by STEP. These include the AN/FCC-100(V)7 LSTDM, the TD-1337(V)1 TSSP, and the TIMEPLEX LINK/2+. The TD-1389 LRM will remain as a submultiplexer to the TD-1337. The IDNX multiplexers are also being added under the DSCS upgrade. To use the STEP equipment most efficiently, circuits should be NRZ format when possible, vice CDϕ.

    j. <u>AN/FCC-100(V)7 LSTDM</u>. The AN/FCC-100(V)7 LSTDM is a modern, economical multiplexer that is widely used by the Services. In STEP, the AN/FCC-100(V)7 will function as a submultiplexer to the TIMEPLEX LINK 2+ and to the TD-1337 TSSP. The AN/FCC-100(V)7 has a maximum aggregate rate of 2.048 Mbps and NRZ port rate of 768 Kbps. Both of these capabilities greatly exceed those of the TD-1389 LRM (256 Kbps, 56 Kbps). The multiplexer carding will consist predominantly of synchronous data port cards and the NRZ aggregate cards for interfacing with the TD-1337 TSSP. Single STEP sites will have three TRI-TAC and three Navy AN/FCC-100(V)7s. Dual sites will have five TRI-TAC and four Navy AN/FCC-100s. These configurations include spares. See Appendix B to Enclosure B for more information on the AN/FCC-100.

    k. <u>TD-1337(V)1 TSSP</u>. The TD-1337(V)1 TSSP is the TRI-TAC high-level multiplexer located in GMF and triband SATCOM terminals as well as the current entry points. Under STEP, the "spoke" version TD-1337(V)2s are being changed to "hub" version TD-1337(V)1s. The purpose of this change is to expand the number of TRI-TAC entries supported from one to four per TSSP. The TSSP has a maximum aggregate rate of 4664 Kbps and a port rate of 1152 Kbps. The TSSP port side can support up to eight channels at ≤576 Kbps or up to four channels at ≤1152 Kbps. Current GMF terminal aggregate data rates usually do not exceed 2 Mbps. Single STEP sites will have two TSSPs and dual sites three, one of which is a spare. See Annex A to Appendix A to Enclosure D for more information on the TD-1337.

(1) The enhanced TSSP (ETSSP) capability will be provided at STEP with the fielding of the Multiplexer Integration and DCSS Automation System (MIDAS) and the exercising of the ETSSP option. The ETSSP supports up to six spoke trunks at an aggregate rate of 8.216 Mbps. The 12 ports can support up to 2,048 Kbps each. The ETSSP will have a mode that is compatible with the current TSSP.

l. TD-1389 LRM. The TD-1389 is the primary TRI-TAC LRM located in GMF and triband SATCOM terminals as well as at the current entry points. The LRM is used to multiplex low rate data and voice into an aggregate for transmission to the TSSP. The LRM port-side data rate is limited to 56 Kbps and the aggregate data rate is limited to 256 Kbps. For the TD-1389 LRM, the voice interface is usually analog. Single STEP sites will have three LRMs, and dual sites will have five, including spares. See Annex A to Appendix A to Enclosure D for more information on the TD-1389.

m. TIMEPLEX LINK 2+. The TIMEPLEX is the Navy's primary multiplexer because of low overhead, networking capabilities, and other Navy criteria. The TIMEPLEX serves as the backbone for the ADMS, formerly the NAVTACNET, global communications grid. The TIMEPLEX Link 2+ provides advanced bandwidth efficiency, integrated communications, resident network management capabilities, and full integration of voice, data and high-speed data transmissions over full or fractional T1/E1 trunks. The TIMEPLEX can process up to 7 T1 trunks, or 5 E1 trunks, or as many as 12 trunks operating at lower aggregate data rates. Each trunk can operate at a different aggregate rate as low as 4.8 Kbps and can be bulk encrypted, if required.

(1) The TIMEPLEX advanced bandwidth efficiency capability provides for contention resolution in allocating scarce bandwidth, pooling bandwidth for reserved usage, priority preemption of channels, diverse or selective routing, and configuration grooming for optimum channel performance. The resident management capability provides a Supervisory Port equipped with node-level password protection for network security. Although the TIMEPLEX is similar in function to the IDNX, it is not compatible on the trunk side. All connections between TIMEPLEX and IDNX will be made on the channel or port side. The Navy is buying all TIMEPLEX hardware and is responsible for its network management.

4. <u>Expected STEP Upgrades</u>

    a. <u>MIDAS</u>. Multiplexing and switching functions at most STEP sites will be provided by MIDAS, which is being procured by the US Army Communications and Electronics Command (CECOM). This system will replace several types of existing discrete multiplexers and TRANSEC devices by emulating the functions of those units, while occupying substantially less facility floor space. The initial MIDAS will provide multiple instances of TD-1337, TD-1389, and T1 multiplexer functions, including fractional T1, subrate (DS0B), and T1 transcoder capabilities. The MIDAS will allow programming of the TD-1337 as spoke, hub or ETSSP. Backward compatibility with fielded GMF equipment will be maintained, and supportability problems from the aging equipment inventory will be eliminated. In addition, MIDAS options on contract include T1, AN/FCC-100(V)7, enhanced TD-1337, and high-speed multiplexer functions, as well as embedded KG-94/-194/KIV-19 compatible TRANSEC devices. KY-57/58 devices will also be installed. The basic MIDAS equipment enclosures and common functional elements will be sized to permit these optional features to be readily added in fielded MIDAS systems by installing appropriate circuit boards. MIDAS will replace numerous manually operated patching racks and will automate the routing of traffic within the STEP site, providing more responsive support to rapidly changing DISN deployed requirements while reducing site manpower requirements. The MIDAS will feature interfaces compatible with associated IDNX, (see Figure H-5), TIMEPLEX (see Figure H-6), and SMU equipment (see Figure H-7), at the STEP site. MIDAS will include nonproprietary expandability features, allowing growth in capacity and the addition of evolving state-of-the-art capabilities, including equipment based on asynchronous transfer mode (ATM) protocols (see Figure H-8). MIDAS will offer an ATM I/O that will feature OC-3c, 3 ea. DS-3, T1, and E1 cell-bearing interfaces. MIDAS has an ATM processor card which will provide switching and SARing functions. And each ALA-3006 card will provide ATM-specific link conditioning and rate conversion to RS-449 serial interface for up to 6 satellite modems. The ATM segment will also employ COTS ATM software and utilize a COTS 1-Gb ATM cell buss for ATM cell traffic. The system architecture will be based on the availability of COTS components, permitting a substantially shortened procurement and fielding schedule. MIDAS, with its ETSSP, and the introduction of the universal modem system (UMS) (see Figure H-9), will generate the requirement for additional equipment, such as frequency converters.
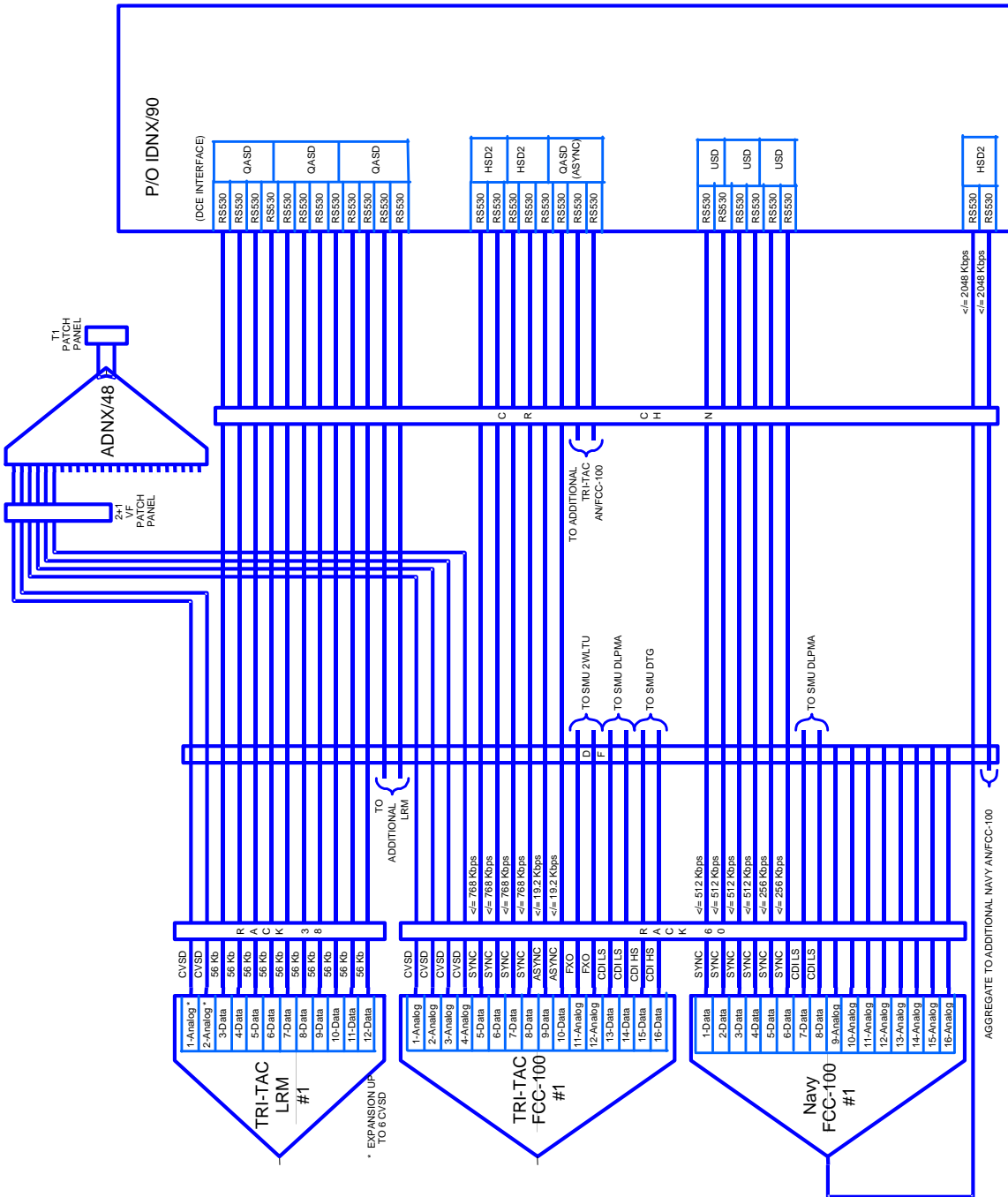
Figure H-5. IDNX STEP Multiplexer Interfaces
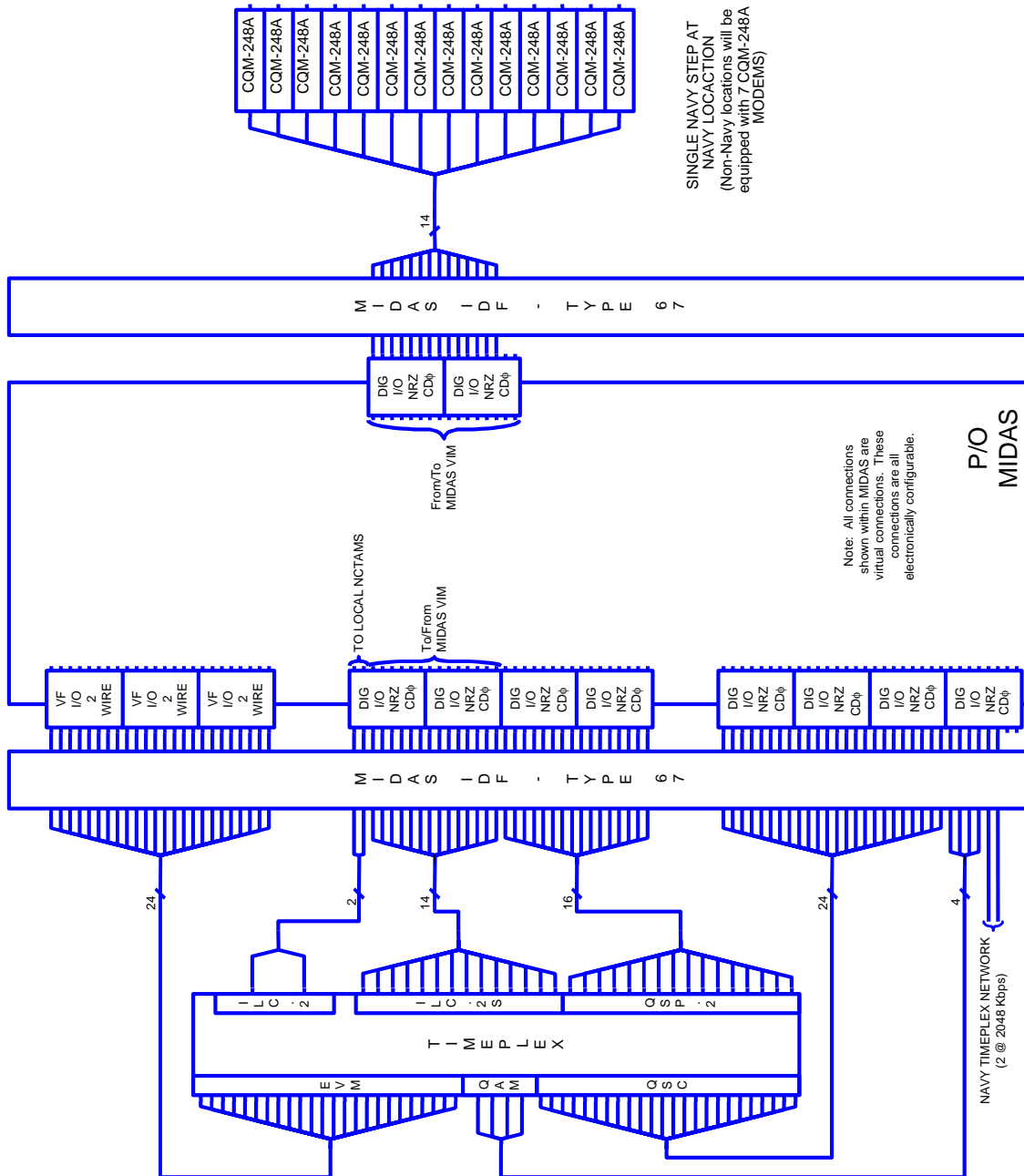
Figure H-6. MIDAS Navy TIMPLEX Interface

Figure H-7. MIDAS SMU Interfaces

Figure H-8. MIDAS ATM

Notes:
1. All connections shown within MIDAS are virtual connections. These connections are all electronically configurable.
2. Navy STEP at Navy locations will be equipped with 14 CQM-248A MODEMS (including 2 spares). Navy STEP at non-Navy locations will be equipped with 7 CQM-248A MODEMS (including 1 spare).
3. DISN interfaces will be provided by either T1 Multiplexers or ATM.

All STEP sites with the exception of Camp Roberts are being converted to the MIDAS configuration, from IDNX, beginning with the Ft Gordon test and training site in March 2000. All sites are expected to have the MIDAS by June 2001. The Camp Roberts STEP site is being directly configured to MIDAS, bypassing the IDNX phase.

b. <u>Universal Modem System</u>. The MCEB has directed the program manager for universal modem to create a commercial production version of the UMS. The UMS will provide antijam, antiscintillation and low probability of exploitation communications for ground fixed, ground transportable, airborne and shipborne users. The UMS will provide interoperable SHF satellite communications between United States, United Kingdom, France, and other NATO forces. The UMS will use nonprocessing transponders, including those of DSCS II, DSCS III, SKYNET 4, NATO III, NATO IV, TELECOM II, future SHF military satellite communications, and commercial satellites (C- and K_u-Band).

(1) The UMS will form the basis for interoperable, antijam satellite communication for data rates up to 8.448 Mbps. For LDR (75 bps to 19.2 Kbps), the objective is to be fully compatible with the existing Interoperable Waveform Standard (IWS) baseline capability. For MDR (16 Kbps to 20.0 Mbps), the objective is to provide frequency division multiple access (FDMA) communications and to form the baseline for future interoperable waveforms.

c. <u>ATM Switch</u>. Tactical circuits are transitioning from using time division multiplexers to ATM technologies. ATM switches will be integrated into the STEP design at some point. Critical ATM standards must be established and tactical fielding plans must be determined, including satisfactory resolution of satellite transmission issues, before installation of ATM switches at STEP can occur.
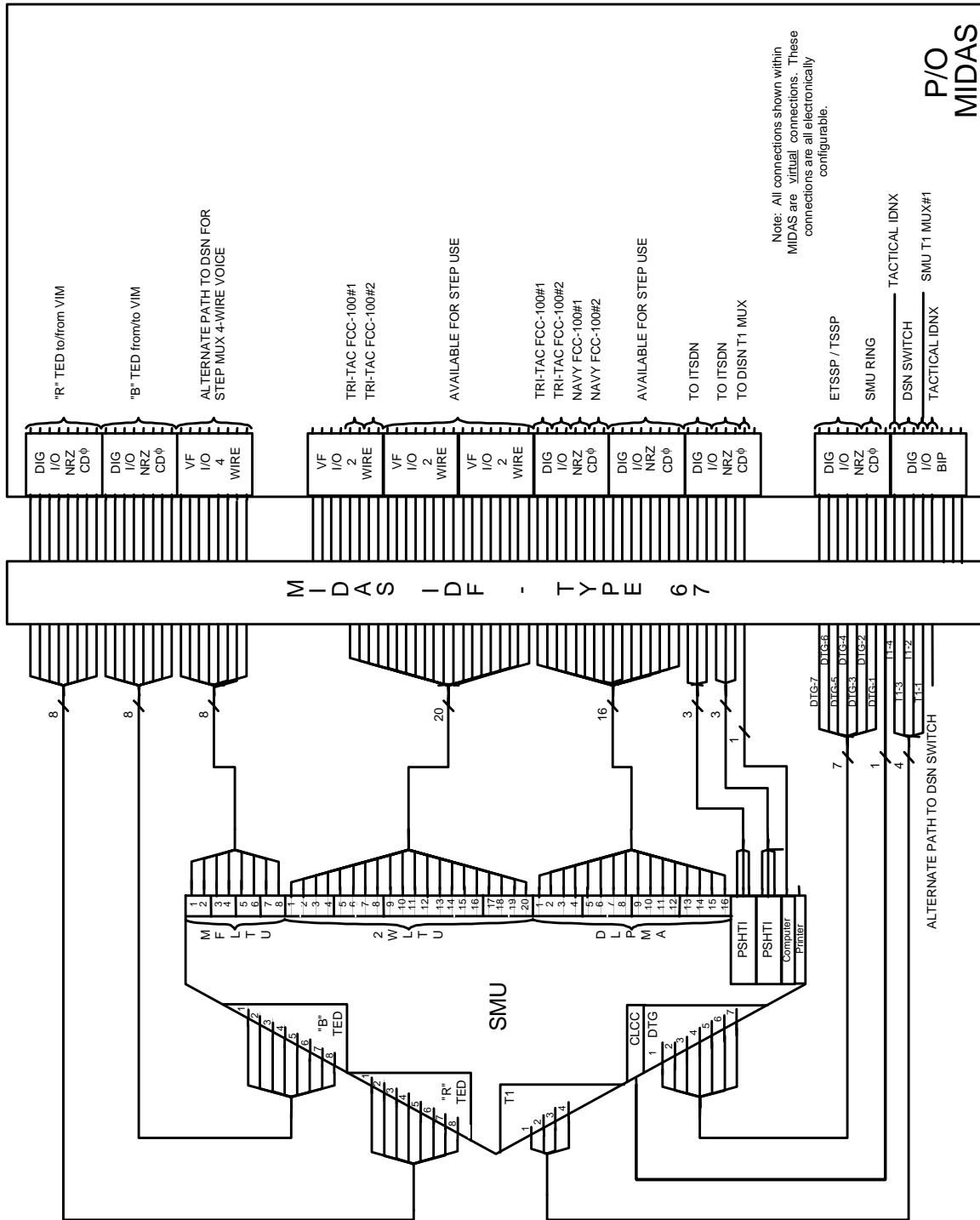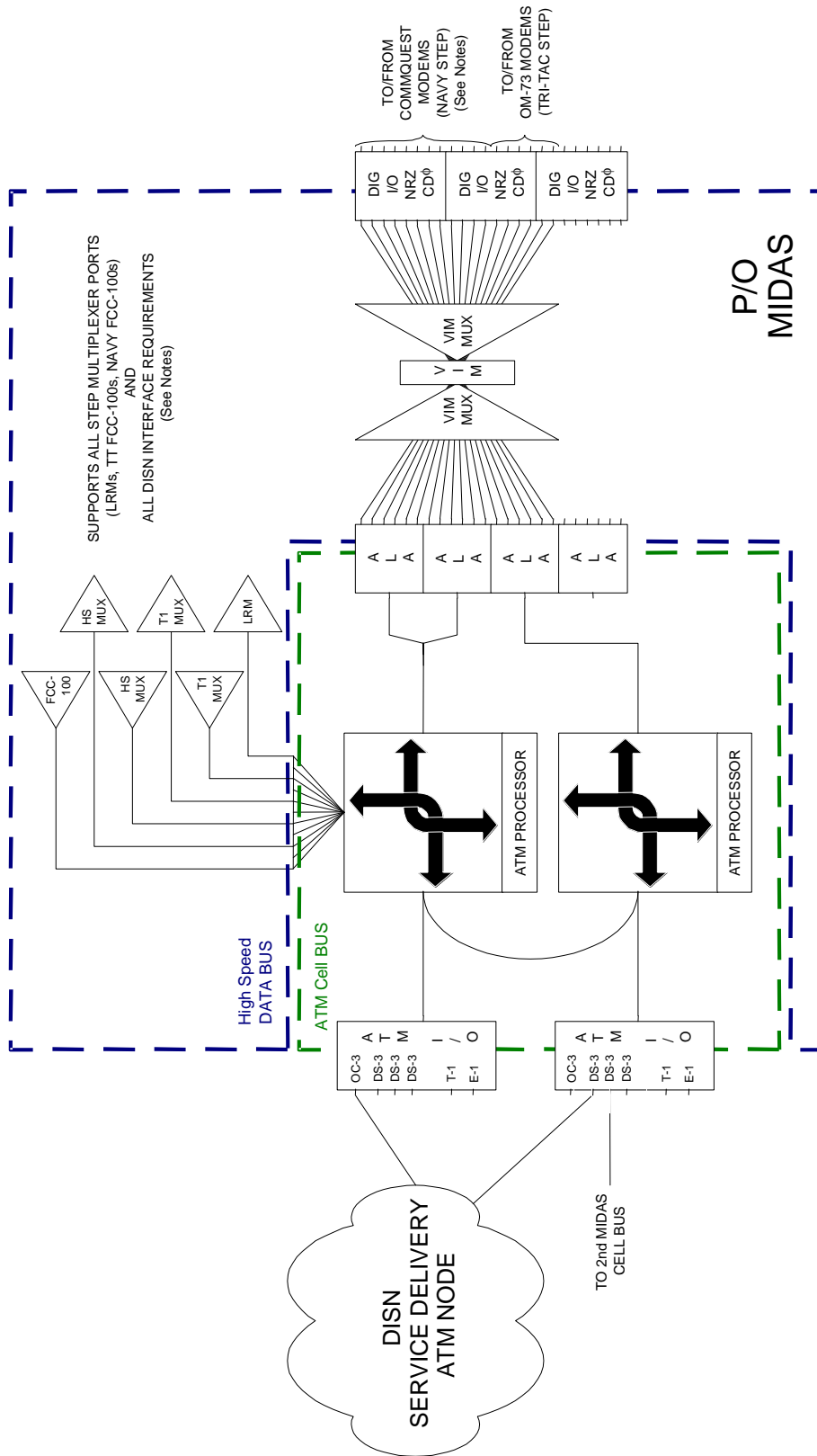
Note: All connections shown within MIDAS are virtual connections. These connections are all electronically configurable.

P/O
MIDAS

DIG I/O CDφ NRZ

DIG I/O CDφ NRZ

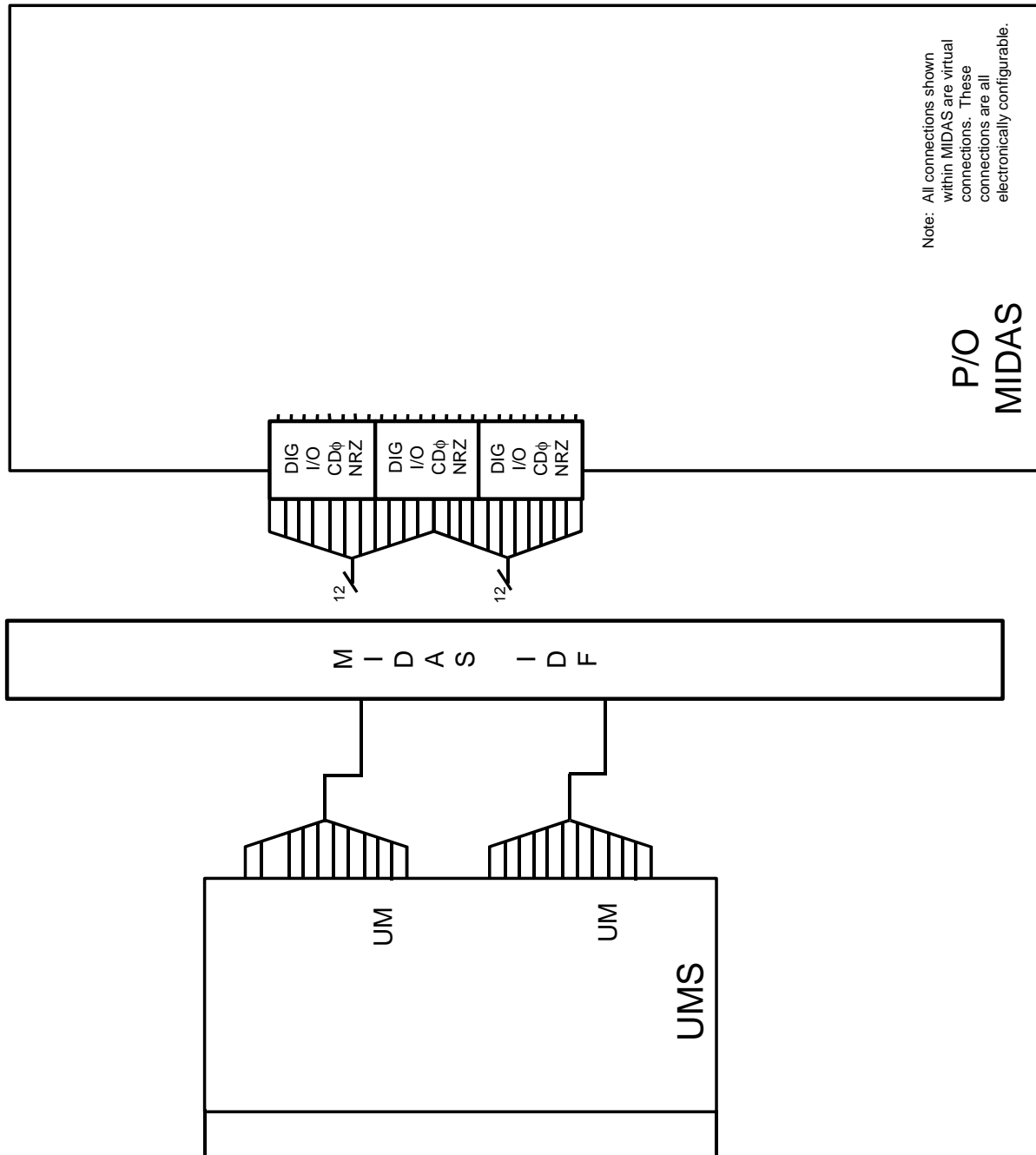DIG I/O CDφ NRZ

¹²

¹²

M I D A S I D F

UM

UM

UMS

Figure H-9. STEP Universal Modem System Interface

d. Equipment Transition. Table H-3 shows the expected transition periods of baseband equipment types. Currently STEP sites are equipped with legacy TRI-TAC and IDNX equipment. The TRI-TAC equipment will meet backward compatibility requirements, as well as support new TRI-TAC equipped triband satellite terminals. The IDNX will support the ongoing deployable equipment procurements by the Air Force, Marine Corps, the JCSE, and CINCs. It is expected that STEP ATM fielding will be in addition to TRI-TAC and IDNX equipment types, because as long as equipment can be deployed, STEP must be capable of supporting it.

Table H-3. Expected STEP Baseband Equipment Transition Periods

TRANSITION PERIOD	STEP Baseband Equipment Types
PRESENT	TRI-TAC & IDNX
FIRST PERIOD	TRI-TAC & IDNX & ATM
SECOND PERIOD	ATM & UMS

e. Teleport Concept. The current pre-positioned connection into the DISN Long-Haul Block is over the DSCS SHF system through the STEP sites. The STEP capacity is limited in the initial phases of a typical deployment to a surge capacity of about 11 Mbps at a single STEP site. Per the STEP CONOPS, a deployed JTF/CTF should be supported by a minimum of four single STEP sites, for a total of about 45 Mbps. The total validated bandwidth requirement for the year 2000 from the Joint Staff DISN Deployed Strategy is 102 Mbps. STEP currently lacks sufficient interfaces and pre-positioned connectivity to the DISN services to support this requirement. The DOD Teleport concept will provide confluence and integration capabilities, as well as sufficient contingency capacity, for commercial and military satellite interfaces, terrestrial, and fiber media to meet the DISN Long-Haul Block and DISN Sustaining Base Block needs of the deployed warfighter in a seamless, interoperable, and economical manner.

(1) Type of System Proposed. The proposed DOD Teleport System is a telecommunications collection and distribution point providing deployed forces with sufficient bandwidth, multiband and multimedia connectivity from deployed locations anywhere in the world to online DISN Service Delivery Points (SDPs). This system will provide the

interoperability between multiple MILSATCOM systems that allows the user a seamless interface into the DISN. The DOD Teleport will add capabilities to a subset of existing STEP sites providing satellite connectivity for deployed tactical communications systems operating in the X- (DSCS), C-, K_u, military and civilian K_a, and EHF (MDR) bands to develop a worldwide common user Communications Confluence Center. This center will integrate dissimilar transports links, ground entry points, and customer interfaces into a logical single point of presence for customer entry, economical transport interface, and information distribution. Interfaces between the DOD Teleports and the Global Network Operations and Security Center (GNOSC), the Regional Network Operations and Security Centers (RNOSCs), and Joint SATCOM Support Center (JSSC) will be configured in the functional design. Eventually, the UHF, EHF (LDR), and L-Bands will be added as the satellite systems operating in these bands are launched and configured. Although related, it is not envisioned for the Global Broadcast Service (GBS) or the Mobile Satellite Services (MSS) to be core elements of the DOD Teleports. There is some synergy to locate DOD Teleports in proximity of the satellite facilities of these systems, but this is not required.

(2) Prior to the full implementation of the teleport at selected STEP (Phase II) sites, DISA plans to implement C band, K_u band, and commercial access along with expanded DISN services. These selected sites will be known as Enhanced STEP (E-STEP). Six DOD Teleport sites are the envisioned complement needed to meet the worldwide coverage requirements. Potential locations could be in east and west CONUS, east and west Pacific, Europe, and Asia/Africa. Analysis must be conducted to finalize the correct, true complement of sites required. Additionally, a DOD Teleport site could be engineered in a virtual or logical configuration. That is, the military and commercial terminals need not exist at the same physical facility as long as they are located within a reasonable distance of each other, allowing economical interconnections. Thus, while the ground terminals, gateways, and control elements may be physically separated, the DOD Teleport appears as a single point of presence to a user. This approach may be required where limitations (physical, political, etc.) exist that preclude the establishment of a DOD Teleport on a single site. Regardless, each DOD Teleport will provide immediate and seamless access to the DISN voice, data, and video SDPs from a wide complement of satellite, fiber, or ground transmission media. Finally, DOD Teleports will require central management and control.

(b) <u>Deployed Tactical Connectivity</u>. Serve as a hub in a hub/spoke configuration to provide connectivity within a deployed tactical area. This connectivity provides enhanced service to disadvantaged deployed users, particularly rapid-response units unable to transport large amounts of equipment.

(c) <u>Relay Within the Same Band</u>. Allow a deployed user to communicate with other users on the same satellite communication system, but on a different satellite because of satellite coverage limitations. This is an effective way to extend the range of SATCOM links that do not have a satellite crosslink capability.

(d) <u>Cross-Banding</u>. Provide satellite communication connectivity between deployed forces using different satellite systems; i.e., SHF to UHF, EHF to SHF, etc. Cross-banding will be accomplished within the DOD Teleports at the baseband level.

(e) <u>Multiplexer and Baseband Translation</u>. Provide multiplexer translation to users in the theater on the same communications system. Selective baseband translation should be implemented where feasible. (Full baseband translation is not considered practical because of the high cost associated with developing and maintaining the multiple translation algorithms required to support the large number of baseband devices needed.)

(f) <u>Switching and Routing</u>. DOD Teleports will support automated routing of all SATCOM accesses to the DISN Long-Haul Block when feasible.

(g) <u>Bulk Encryption/TRANSEC</u>. Receive and pass-through encrypted information as a normal function. It will also separate bundled encrypted information in preparation for transmittal to and decryption by the addressed customer.

5. <u>Non-STEP Equipment Related Programs</u>

a. This section describes several other programs that impact STEP and improve tactical user service. Often, these programs are considered part of STEP. These programs include the DSCS IDNX upgrade, the ITSDN quick fix upgrade, HT/MT modernization, AN/GSC-52 modernization, and the Commercial Satellite Communications Initiative

(CSCI). These programs are illustrated in Figure H-11 along with some new tactical terminal programs. STEP functionality is influenced by the fielding of these related programs.
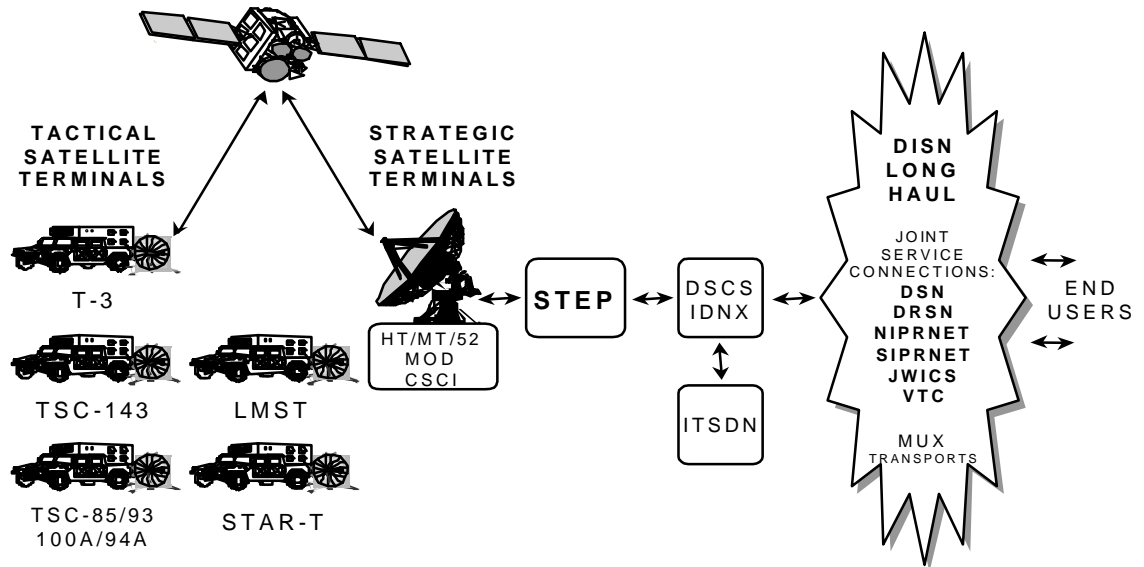
Figure H-11. Programs Related to STEP

b. <u>DISN Deployed Strategy</u>. The DISN deployed strategy will improve communications support to the deployed forces by integrating and coordinating the use of transport media including C-Band, X-Band and K_u-Band SATCOM, MILSTAR, MSS, HF, GBS, UMS, and Global Grid. Pre-positioned DISN connectivity will be efficiently used by allowing access by all of these media. STEP is the DSCS portion of the DISN deployed strategy and forms the foundation for creating the DISN deployed concept. In the DISN deployed strategy concept, the concentration of multiple media antennas and pre-positioned services is called a teleport. Requirements not supported by STEP will be identified, funded, and fielded in support of the DISN Deployed Strategy.

(1) STEP will provide deployed forces connectivity to the strategic DISN during all phases of JTF operation. These deployment phases are described below and are shown graphically in Figure H-12.
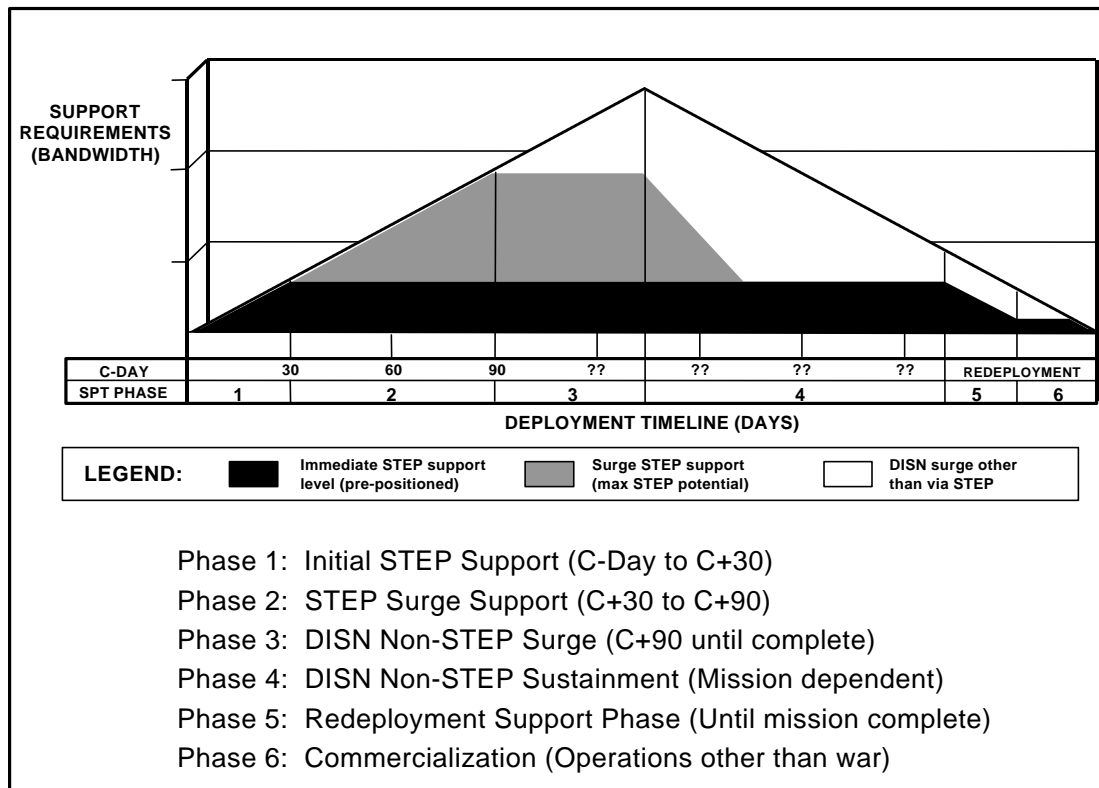
Figure H-12. DISN Deployed Mission Support Profile

(a) In phase one, initial STEP support, forces arriving in the AOR will have immediate access to STEP and the pre-positioned DISN connectivity. At this time, STEP may be the only method of providing out-of-theater support. If the deployment's DISN requirement is expected to exceed what is pre-positioned, then planners and operations personnel should begin paperwork to expand or "surge" the STEP DISN capacity.

(b) In phase two, STEP surge, increased DISN capability is activated by bringing up leased circuits or reallocating government furnished transmission media. This surge in capability can increase up to the STEP equipment maximum capacity. If the deployment's DISN requirement is expected to exceed the STEP equipment capacity, then plans must be made to activate non-STEP non-DSCS assets such as commercial satellites and gateways.

(c) In phase three, non-STEP surge, non-STEP non-DSCS assets are activated to provide the maximum JTF support level. STEP is used to its maximum capability.

(d) In phase four, non-STEP sustainment, STEP begins to deactivate its surge capability support. This capability is transitioned over to the non-STEP assets. This begins freeing up the STEP equipment for other missions that may arise.

(e) In phases five and six, redeployment and commercialization, STEP is used minimally or as required.

6. <u>Tactical Configurations Supported</u>. This section describes the tactical SATCOM terminals and the baseband configurations for these terminals as supported by STEP.

a. <u>GMF Terminals</u>. STEP was designed primarily to improve support to the approximately 400 existing GMF terminals including the AN/TSC-85B, AN/TSC-93B, AN/TSC-100A, and AN/TSC-94A terminal types. The baseband equipment used in these terminals is based on the TD-1337 TSSP, and the TD-1389 LRM. STEP is also designed to support the AN/TTC-39 and AN/TTC-42 families of circuit switches that usually accompany these SATCOM terminals.

b. <u>Navy Ship Terminals</u>. STEP supports Navy afloat units equipped with the AN/WSC-6 variants. Navy ship baseband is designed to interface the TIMEPLEX and AN/FCC-100 multiplexers. Accordingly, they are procuring this equipment to connect to the STEP configuration. The Navy prefers to terminate all ships at its four primary sites supporting NCTAMS. The goal is to be able to support up to two carrier battle groups and one amphibious readiness group in each of the five satellite areas and to provide for a surge during a two-MRC contingency. Upon full STEP fielding, up to 18 ships per satellite area will be supported by three or more STEP sites. Most satellite areas have three STEP sites, each supporting up to six ships.

c. <u>Tri-Band Terminals</u>. STEP will support the expanding number of different Tri-Band terminals, provided the terminal baseband equipment is compatible with the STEP configuration. To ensure compatibility, the user community should consider the STEP baseband configuration when planning future terminal procurements.

d. Tactical IDNX. Tactical use of IDNX is expected to continue to increase. When using the IDNX, there are two main STEP configurations for user consideration. One configuration continues to use TD-1337 TSSP, and the other by-passes the TSSP. For low-rate trunks, the use of the TD-1337 as the high-level multiplexer is recommended for conservation of equipment assets. It is acknowledged that more IDNX bandwidth may be required to interface the limited TSSP rates. High data rate trunks such as T1s will require bypassing the TSSP thereby limiting the use of hub/spoke operations. This mode limits the number of tactical accesses at a STEP because more upconverters and modems are required. Each DSCS IDNX at STEP will provide two SA-TRKs for tactical IDNX use. Under the DISN deployed strategy, the number of SA-TRKs required at each STEP to support Theater Deployable Communications will be reassessed and provisioned as required.

e. SCAMPI. The SCAMPI system consists of deployed and strategic nodes which support the JSOTF component of a JTF. The SCAMPI system is IDNX based with multiple security levels and is basically identical on each end. SCAMPI is able to use GMF and other SATCOM equipment for transport to connect the deployed node to the STEP. The STEP terrestrial transmission is used to connect to the strategic SCAMPI gateway. At the deployed node, a SCAMPI trunk will pass from the SCAMPI BLACK IDNX SA-TRK card to a TED for encryption. After transmission to the STEP site, the data will interface with the HSD-2 card in the DSCS IDNX for pass-through to the distant end SCAMPI site/IDNX. No circuit breakouts at the STEP are possible with this configuration. Other multiplexers may also be used in the path to maintain interoperability. The use of the TSSP is preferred to conserve assets at the STEP site.

7. DISN Network Connections Provided by STEP

a. STEP provides the interface between tactical users and DISN networks. This section describes the standardized JVDN capabilities provided to JTF/tactical users via STEP and describes the related terrestrial connectivity required to transport these services to STEP. These DISN networks include DSN and DRSN for voice; NIPRNET, SIPRNET, and JWICS for data and special-user video; and VTC for common-user video.

b. DISA is coordinating pre-positioned connectivity from each STEP to each joint network's backbone router, hub, or switch. The user is responsible for the connectivity between the backbone equipment and the end user's strategic post, camp, and station equipment. Table H-4 shows these requirements in the form of joint voice and data networks. This is a consolidation of applications and networks shown in the STEP design plan. It should also be noted that CJTF and MARFOR requirements, when embarked afloat, are in addition to NAVFOR requirements.

(1) Table H-5 is an updated and expanded list of estimated JTF requirements that is intended to reflect the mature JTF Theater DISN deployed bandwidth requirements in the year 2000 and is intended as a guide for engineering and terrestrial transmission decisions. STEP and DSCS can support a significant fraction of this 102-Mbps requirement; and the remainder must be supported with commercial SATCOM, MILSTAR, GBS, MSS, and other transmission systems. Current and future tactical terminals support trunks of about 2 Mbps over DSCS. To satisfy the total JTF requirement out of theater into DISN, many multiple-frequency dedicated SATCOM terminals are required. Intra-theater requirements are not included in Table H-5.

(2) The STEP portion of the total JTF requirements is met with a minimum of three STEP sites (two single sites and one dual site) producing an equipment count equivalent to four single sites. Most JTF deployments will have access to multiple DSCS satellites and more than three STEP sites. Each single STEP has a maximum baseband equipment throughput capability of over 13 Mbps. A realistic STEP throughput estimate is less than 11 Mbps. The DSCS satellite capacity is usually the limiting factor because of the number of small tactical terminals accessing STEP sites.

Table H-4. Validated Minimum Initial JTF Requirements Into DISN

SERVICE /Kbps	CJTF	ARFOR	NAVFOR	AFFOR	MARFOR	JSOTF
DSN	288, 8	144, 4	144, 18	144, 4	144, 4	144, 4
DRSN	-----	-----	-----	-----	-----	-----
NIPRNET	56	56	56	56	56	56
SIPRNET	56	56	56	56	56	56
JWICS	56	56	56	56	56	56
VTC	-----	-----	-----	-----	-----	-----
Sub Totals	456	312	312	312	312	312
Grand Total	2016					

(3) Table H-6 shows the pre-positioned services. The ITSDN is providing NIPRNET and SIPRNET access at 10 sites. The VTC access is still undetermined at this time.

(4) Joint-user DISN network connections are intended for short-term use only during exercises, operations, and training. Activation of these services is done through DISA contingency operations divisions in CONUS, Pacific (PAC), and Europe (EUR). The Navy has Service-unique requirements in addition to the core C4I services and must maintain continuous access to at-sea units. To efficiently support this continuous access, the Navy uses ADMS to provide both joint and Navy-unique services to the ship and embarked commanders.

Table H-5. Estimated Mature JTF DISN Requirement

	THEATER LEVEL ELEMENT						NAVFOR ELEMENT	
	DISN DEPLOYED SEGMENT						DEPLOYED SEGMENT 8 LINKS	4 LINKS
TOT RQMT (Mbps)	JTF HQ 9.248	COM NAVFOR 4.616	AFFOR 13.686	ARFOR 14.536	MARFOR 8.360	JSOTF 6.816	CVBG 16.264	ARG 12.040
NETWORK	JTF	COM NAVFOR (FLAGSHIP)	AFFOR	ARFOR	MARFOR	JSOTF	CVBG	ARG
SIPRNET	1544	256	3600	1544	1544	1544	1024	1024
NIPRNET	1544	256	3270	1544	1544	1544	1024	1024
JWICS	1544	1544	1544	1544	1544	1544	4360	3592
DSN	3840 (60)	1920 (30)	3088 (48)	3088 (48)	3088 (48)	1544 (24)	4096 (64)	2816 (44)
DRSN (Red Switch)	256 (4)	128 (2)	128 (2)	128 (2)	128 (2)	128 (2)	640 (10)	384 (6)
DCTN VTC	512	512	512	512	512	512	4608	2560
TELEMEDICINE		0	1544	6176			512	640
TOTALS (Mbps)	9.240	4.616	13.686	14.536	8.360	6.816	16.264	12.040
NOTES: Requirements are expressed in terms of Data Rates (Kbps)/trunks unless otherwise stated. Subordinate NAVFOR elements are included due to the requirement for STEP to support deployed Naval Forces. NAVFOR requirements are based on task organization of (2) CVBG's and (1) ARG.								

Requirements: Six Theater Level Elements   57.254 Mbps
Subordinate NAVFOR Elements   44.568 Mbps
Total Theater Requirement   101.822 Mbps

(5) Table H-6 shows the pre-positioned DISN network connections provided by a single and dual STEP site. The goal of STEP is to pre-position services and connectivity as depicted. A dual site will have twice the services of a single site. Details of the services provided by a single STEP are outlined in the following paragraphs.

c. Voice Services. The STEP will provide tactical users access to DSN, DRSN, and the Navy voice network. Descriptions of these services for a single STEP site follow.

(1) DSN. The DSN will be the primary voice network supporting the deployed forces. To provide this support one T1 (1544 Kbps) access circuit will be pre-positioned between the STEP SMU and the DSN. This T1 during normal operations provides 24 DSN ISTs. During the STEP surge support phase, this circuit will be transcoded/compressed to provide 44 ISTs. The IDNX transmission and compression may be used if certified for DSN operation. These ISTs will allow users to place non-secure tactical calls and secure STU-III calls to other DSN subscribers.

Table H-6. Pre-Positioned DISN Network Access
(Single and Dual STEP)

DISN Networks	Single STEP Site	Dual STEP Site
DSN	1544 Kbps = 24 chan	2 x 1544 Kbps = 48 chan
DRSN	3 x 56 Kbps = 6 chan	6 x 56 Kbps = 12 chan
NIPRNET	512 Kbps = 8 ports 1/	512 Kbps = 16 ports
SIPRNET	512 Kbps = 8 ports 1/	512 Kbps = 16 ports
JWICS	1544 Kbps = 2 chan	2 x 1544 Kbps = 4 chan
VTC	512 Kbps to T1	512 Kbps to T1

1/= 16 router ports available with reconfiguration

The SMU operates in the DSN as a standalone (SA) DSN switch. An SMU SA switch provides tandem support only. DISA will manage the SMU as an integral part of the DSN. A user program designator code (PDC) billing code is always required for DSN service activation. However, for tactical access of 30 days or less, no DSN usage (per minute) charges will be billed against the PDC. See Table H-1 for the servicing bandwidth manager (BWM) and switch locations supporting STEP.

(2) DRSN. The DRSN is the primary secure voice network supporting the deployed forces. To provide this support, three 56 Kbps circuits will be pre-positioned between each STEP and a DRSN switch. To terminate these circuits, three dual trunk adapters (DTAs) and three KGs will be installed at the supporting strategic Red Switch. At the deployed subscriber site, the supporting O&M will have to provide all terminating equipment (phone, DTA, dual phone adapter (DPA), etc.). Each 56-Kbps circuit provides two ISTs to a deployed Red Switch or two DRSN long locals to a deployed location with red phones. These six ISTs will allow users to place secure Red Switch calls from the field or at-sea. The DRSN surge capacity can be supported by activating additional circuits when additional bandwidth is available. Currently, DRSN charges are not applied on a per minute basis, so the tactical user will not be charged directly for DRSN access and usage. Contingency keymat for STEP circuit activation will be maintained at the switch locations. It is the responsibility of the user community to coordinate with the supporting switch for keymat for contingencies, exercises and training.

Currently, with proper coordination, the highest supported classification level is TOP SECRET.

(3) <u>Navy Voice Service</u>. During CINC- approved training and exercises, the Navy can use the pre-positioned DSN and DRSN services described above. For all operations, the Navy will provision their own voice services using ADMS via the STEP TIMEPLEX multiplexer. The Navy uses the TIMEPLEX and AN/FCC-100 multiplexer equipment because the voice compression features allow for efficient SATCOM utilization. Navy voice channels can be broken out of the TIMEPLEX and connected directly to the SMU with analog trunks or DTGs. This provides direct voice dialing by Navy subscribers to other service components with TRI-TAC or MSE switches connected to the SMU.

d. <u>Data Services</u>. STEP provides tactical users access to the Joint Data Networks: NIPRNET, SIPRNET, and JWICS. Descriptions of these networks (services) follow.

(1) <u>NIPRNET</u>. The NIPRNET is the primary unclassified-but-sensitive network supporting the deployed forces. The NIPRNET is a worldwide network of unclassified IP routers that will support applications such as the DMS, combat support local area networks, and the Marine Corps Data Network (MCDN). Under the ITSDN Program, NIPRNET routers are installed at 10 of the 15 STEP sites, and at those sites, a 512-Kbps transmission path is provided from the STEP site ITSDN router to the NIPRNET backbone.

(2) <u>SIPRNET</u>. The SIPRNET is a worldwide network of IP routers that will support secret applications such as the GCCS and the Contingency Theater Air Control System Automated Planning System (CTAPS). Future applications include the DMS and global weather central (GWC). Under the ITSDN Program, SIPRNET routers were installed at 10 of the 15 STEP sites, and at those sites, a 512-Kbps transmission path is provided from the STEP site to the SIPRNET backbone.

(3) <u>JWICS</u>. The JWICS is a worldwide network that provides VTC and data at the sensitive compartmented information (SCI) level. The data portion of JWICS supports applications such as the Intelink JDISS and the enhanced tactical user terminal (ETUT). The JWICS is managed by the Defense Intelligence Agency, and discussions are ongoing to

determine how and if to pre-position tactical circuit connectivity via STEP. If the multiplexers on the tactical side are RED, then STEP would likely pass the trunk encrypted circuits through DISN to connect to a RED-user multiplexer on the strategic side. The COMSEC keymat for STEP circuit activation will be maintained at the JWICS hub locations. It is the responsibility of the user community to coordinate for service with the Joint Staff, J2-O, (703) 697-0080, and the JWICS Program Management Office, (202) 231-2969, DSN 428-2969.

(4) <u>Navy Data Services</u>. The Navy will establish its own data transmission access to joint networks in support of day-to-day mission requirements and may utilize STEP-provided JVDN services when supporting Joint operations.

e. <u>Video Services</u>. The STEP will provide tactical VTC users access to strategic VTC users on the DISN. Depending on the data rates and access arrangements used to connect to the STEP, VTC users will be able to make secure and nonsecure, point-to-point, and multipoint calls on a dedicated or dial-up basis. To ensure system-wide VTC interoperability, the CODEC utilized by tactical VTC users will be "VTC Industry Profile" compliant. The industry profile is based on the International Telecommunications Union (ITU) H.320 suite of recommendations.

(1) The STEP will be directly connected to the DISN video services hub(s) to accommodate dedicated access arrangements and will be connected to the DISN switched services network to accommodate dial-up access arrangements. Dedicated circuits will use STEP and IDNX multiplexers for transmission through the DISN longhaul segment to the end user location or DISN VTC hub location. The dial-up requirement is not well defined at this time, but will likely be supported by connectivity into the DSN switch network or into the IDNX network. Dial-up is the preferred method of access to the DISN VTC hubs. Secure and nonsecure multipoint calls involving tactical and strategic VTC users will be handled at the video hubs. There are currently three CONUS-based video hubs: Dranesville, VA; Fort McPherson, GA; and San Diego (NRAD), CA. Additional video hubs are being planned for PAC and EUR areas. Moreover, video hubs will likely be required at the JTF forward locations to minimize the need for reach-back to the CONUS-/PAC-/EUR-based hubs for in-theater multipoint calls. This requirement will be especially fortuitous when a multipoint call does not

involve any strategic VTC user or involves very few strategic VTC users, when compared to the number of tactical VTC users.

(2) The requirement for VTC through STEP is that multiple circuits ranging from 128 to 512 Kbps per circuit be supported. Technically, each single STEP site has the capability to support multiple dedicated and dial-up VTC circuits. Programmatically, the issue is that no funding for DISN access or usage charges has been provided to pre-position STEP VTC service.

f. Other Services. STEP and non-STEP equipment is being provisioned to support other data and analog circuits. This extra carding provides an expansion capability and can support Service-unique requirements, if desired. For requirements beyond the pre-positioned services described herein, users must request services using the telecommunications service request and telecommunications service order (TSR/TSO) process.

g. Service Availability. The STEP goal is to have services available to the tactical user in a period of hours, when necessary. To do this, the DISN circuits have to be pre-positioned and up all the time. This implies, for example, that the DSCS IDNX channel and trunk cards as well as DISN circuits are pre-planned and dedicated full period to STEP. This availability is established for the sites that now have ITSDN points of presence. DISA is working on establishing the backbone accesses for the JVDN.

h. Terrestrial Circuit Connectivity. The DISN will provide the terrestrial transport from STEP to a backbone switch, router or hub for those tactical circuits arriving at the STEP via SATCOM. The establishment of terrestrial connectivity from STEP into DISN is being coordinated by DISA. As tactical circuits enter the STEP, they are usually transported to the collocated DSCS IDNX multiplexer for entry into DISN. In some cases, alternate transmission paths are available and may be used. Currently, there are two types of tactical circuit accesses to DISN. One type terminates within DISN, the other passes through the network to reach the distant end. Most voice and data services will terminate within the DISN.

8. <u>Access to STEP and Services</u>. This section provides a summary level description of the current procedures for tactical SATCOM access to STEP and the associated entry point services. The access procedures are outlined for GMF/TRI-TAC and for Navy terminals using DSCS satellites (X-band).

a. <u>Overview</u>. The access process is different for GMF-/TRI-TAC-equipped terminals and Navy TIMEPLEX-equipped ships. The equipment at the entry points is traditionally assigned to support either GMF/TRI-TAC or Navy. The site equipment is managed by DISA for GMF/TRI-TAC access and by the FLTCINC or their designated representative for Navy access. DISA manages DSCS SATCOM power and bandwidth and the Regional Space Support Center (RSSC) provides support with tactical access planning. DISA assigns TRI-TAC users to particular STEP sites according to priorities and equipment/service availabilities.

b. <u>GMF/TRI-TAC Access</u>. The current procedure for CONUS area access to an entry point and satellite is described in the Army Space Command (ASC-3) "GMF Satellite Communications Management Policy and Procedures," and the DISA CONEXPLAN 10-98. This procedure is shown graphically in Figure H-13. DISA EUR and DISA PAC (CONEXPLAN 203-92) have their own similar procedures for entry point access.

(1) The CONUS access procedure is initiated by the tactical planner or unit by sending a gateway access request (GAR) to DISA's Contingency Operations Branch (D333) and a satellite access report (SAR) to the servicing RSSC. (A revised SAR/GAR form is presently undergoing final approval and coordination.) (See 6231.07B Appendix F, for procedures). If the local RSSC cannot determine how best to fulfill the requirements, the SAR will be forwarded to RSSC CONUS, Washington, DC. The entry point access request also specifies the services required by the unit. After determining how best to fulfill the requirements, SHF/GMF mission directive and a satellite access authorization (SAA) are issued to approve the request and provide direction to the units involved. This directive identifies entry points and the associated points of contact (POCs) to establish the access. The priority and purpose of the request determine the speed with which entry point access is granted, as specified in the DISA CONEXPLAN. If contention for entry point access or services cannot be resolved at the

DISA and user level, then the Joint Staff CINC Operations Division, (J6Z), will be the final decision authority.

(2) The NIPRNET and SIPRNET access at the STEP sites is provided by the ITSDN routers. Tactical access to ITSDN is provided only on a temporary basis and may require CINC approval. The ITSDN IP router address assignments for tactical units are obtained and provided by the user. Part two of the SAR should be used for deployable IP address requests if the user does not have assigned deployable block addresses. The SAR IP router address requests are included in the SAA. After the SAA is received, the tactical user should make direct contact with the STEP site to verify all access issues are resolved. Such issues include hours of operation, point of presence (POP) equipment configurations, and IP router addresses.
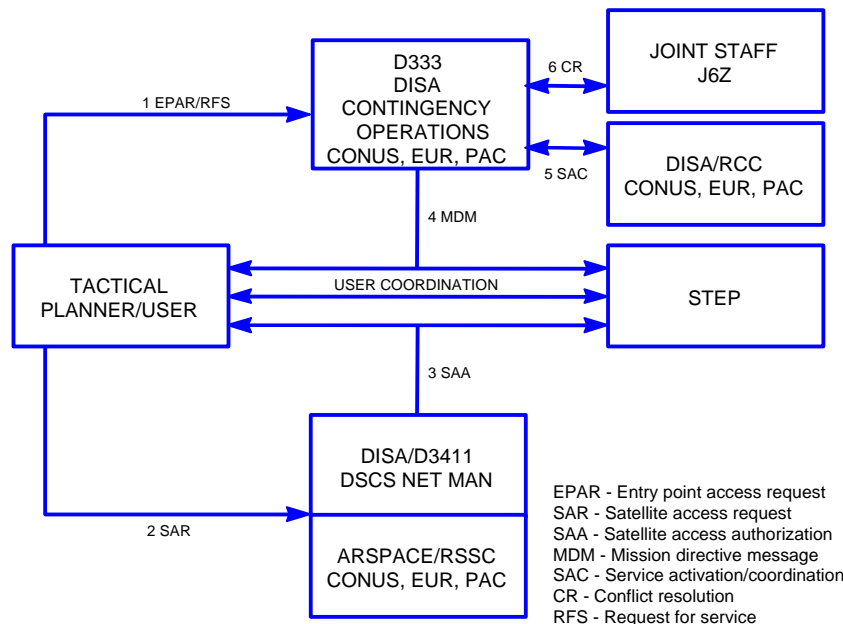
Figure H-13. Satellite/Entry Point/Service Access Process

d. <u>Navy ACCESS</u>. With the STEP upgrade, Navy ships will have access to six more entry points than they access today. The Navy is allocated bandwidth by the DSCS Network Manager. Navy ship entry point accesses are supported primarily at Navy SATCOM facilities served by the three NCTAMS (Northwest at NCTAMS LANT, Wahiawa at NCTAMS PAC, and Lago di Patria at NCTAMS EURCENT), and NCTS Bahrain. Navy access to non-Navy operated STEP sites requires circuits to be terrestrially back-hauled to the nearest NCTAMS or NCTS Bahrain.

Navy access to entry points is limited by the current shortage of converters. Because of operational problems caused by agile IF operation at high data rates, a configuration using a single modem per converter is required. Accesses by Navy ships are the responsibility of the FLTCINC; however, day-to-day management is often delegated to a Numbered Fleet Commander within a specific area of responsibility and/or operation. The procedures for Navy access to STEP services are as follows:

(1) A ship sends a SAR addressed to the Fleet CINC, Numbered Fleet Commander, DSCS Network Manager, and the applicable NCTAMS or NCTS. The SAR contains both the satellite and preferred gateway access requirements and the ship's baseband configuration requirements.

(2) The Fleet CINC, or his designated representative, validates the access request and sends an authorization message to the DSCS Network Manager and applicable NCTAMS/NCTS for assignment. With the exception of COMUSNAVCENT/IO, the Fleet CINCs have delegated this approval responsibility to the Numbered Fleet Commanders (COMSECONDFLT/WESTLANT, COMTHIRDFLT/EASTPAC, COMSIXTHFLT/EASTLANT, and COMSEVENFLT/WESTPAC).

(3) The DSCS Network Manager, after determining how best to fulfill the requirement, sends an SAA to the ship and all concerned.

(4) The applicable NCTAMS/NCTS then issues a baseband configuration message to the ship. If the ship required access to the Joint Voice and Data Services (ITSDN, DSN, DRSN, JWICS, VTC), the ship would alter the SAR format to request such services and include the CINC and DISA's Contingency Branch.

(5) The SAR approval process would filter through the combatant CINC and DISA's Contingency Branch with the space segment assignment provided by the DSCS Network Manager.

(6) A coordinated SAA would be issued by the DSCS Network Manager fulfilling the requirement. Navy access procedures are described in Naval Telecommunications Publication --NTP 2 and NCTAMS Communications Information Bulletins/Advisories (CIBs/CIAs).

e. <u>Activation of STEP Services</u>. The DISA contingency operations codes (CONUS, PAC and EUR) will coordinate with the appropriate RCCs, Network Operation Centers (NOCs), etc., to establish tactical user access to joint pre-positioned services. Navy, SCAMPI, and other users with nonjoint and/or unique requirements must provide for their own terrestrial transmission and service access. In cases where base infrastructure is used to provide services, separate coordination is required with the base itself according to its procedures.

9. <u>STEP Card Information</u>

a. <u>AN/FCC-100 Card Population</u>. Table H-7 shows the card configuration for the TRI-TAC AN/FCC-100 in STEP. See Appendix B to Enclosure B, for other information on the AN/FCC-100.

Table H-7. STEP TRI-TAC AN/FCC-100 Carding

CARD TYPE	LOADED	SPARE	PURPOSE
AN/FCC-100(V)7	1	1	CHASSIS TO HOUSE CARDS, SUPPORTS 16 PORTS
PORT CARRIER	6	2	SUPPORTS PORT-SIDE CIRCUITS, 2 PER CARD
SYNCH. NRZ PORT	8	2	SUPPORTS NRZ SIGNALS ON PORT CARRIER, HIGH-SPEED DATA
BAL PORT TERMINATOR	8	2	SUPPORTS BALANCED ELECTRICAL INTERFACE
ASYNCH. NRZ PORT	6	2	SUPPORTS ASYNC ON PORT CARRIER (LOW-SPEED DATA)
UNBALANCED PORT TERM	6	2	SUPPORTS UNBAL ELECTRICAL INTERFACE
CDφ PORT CARD	0	1	SUPPORTS CDI ON PORT CARRIER (GENERALLY NOT USED)
CDφ TERMINATOR	0	1	CONNECTOR FOR CDI (GENERALLY NOT USED)
DUAL 2-WIRE FXO CARD	1	1	SUPPORTS TWO ANALOG 2-WIRE LONG LOOPS OFF THE SMU
CELP/STU-III DAUGHTER MODULE	2	1	SUPPORTS COMPRESSED VOICE AND STU-III AS LOW AS 4.8 Kbps
DUAL CDφ LOW-SPEED PORT CARD	1	1	SUPPORTS TWO DIGITAL LONG LOOPS OFF THE SMU
COMBINED AGGREGATE CARRIER	0	1	SUPPORTS NRZ & CDI CARRIERS ON AGGREGATE SIDE

Table H-7. (Cont'd)

CARD TYPE	LOADED	SPARE	PURPOSE
RS-422/RS-423 AGGREGATE DRIVER	0	1	BALANCED AND UNBALANCED INTERFACES FOR AGGREGATE
HS CDI DRIVER CARD	0	1	AGGREGATE CARD FOR CDI INTO TSSP
SYNCH. NRZ CARRIER DRIVER	0	1	AGGREGATE CARD FOR NRZ INTO TSSP
TSSP NRZ CARRIER	1	1	NRZ CARRIER SPECIFICALLY FOR USE WITH TSSP
TSSP AGGREGATE DRIVER CARD	1	1	DRIVER SPECIFICALLY FOR USE WITH TSSP
PROCESSOR CCA	1	1	SELF EXPLANATORY
MUX/DEMUX CCA	1	1	SELF EXPLANATORY
FRONT PANEL INTERFACE CCA	1	1	SELF EXPLANATORY
POWER SUPPLY	1	1	SELF EXPLANATORY
FAN PANEL ASSEMBLY	1	1	SELF EXPLANATORY

    b. Navy IOC Card Population. Table H-8 shows the initial card configuration for the Navy equipment in STEP.

Table H-8. Single Navy STEP Initial Operational Capabilities

EQUIPMENT	OPERATIONAL	IN CHASSIS SPARE	STOCK SPARE
AN/FCC-100(V)7 #1			
SYNC NRZ CHNL 1-6	6	0	
DIPHASE CHNL 7-8	2	0	
AGGREGATE	1	0	
AN/FCC-100(V)7 #2			
SYNC NRZ CHNL 1-6	6	0	
DIPHASE CHNL 7-8	2	0	
AGGREGATE	1	0	

Table H-8. (Cont'd)

EQUIPMENT	OPERATIONAL	IN CHASSIS SPARE	STOCK SPARE
AN/FCC-100(V)7 #3 HOT SPARE			
SYNC NRZ CHNL 1-6	0	6	
DIPHASE CHNL 7-8	0	2	
AGGREGATE	0	1	
1 EACH DIPHASE HIGH, LOW CARD WILL BE PROVIDED FOR AS A COLD SPARE			
TIMEPLEX LINK 2+			
* NCL A+ N1(SLOTS 1-2)	2	0	0
DRE 2 N2(SLOT 0)	1	0	1
DRC 2 N1(SLOT 0)	1	0	1
* BPM N1(SLOTS 17-18)	2	0	0
ILC.2(S) N1(SLOTS 3-7)	3	1	1
QSP.2 N2(SLOTS 1-2)	1	1	1
QSC.2 N2(SLOTS 13-15)	2	1	1
QAM 1 N1(SLOT 15)	1	1	1
FAN HOUSING	1	N/A	N/A
POWER SUPPLY CHASSIS	2	N/A	N/A
NEST CHASSIS	2	N/A	N/A
* NOTE: System Provides Built In Redundancy			
COMQUEST MODEM	6	1	0

 c. SMU Card Population. Table H-9 shows the optional carding for a nonredundant-COMSEC capable SMU 96.

Table H-9. Single STEP SMU Carding (User Cards)

CARD TYPE	LOADED	STOCK SPARE	PURPOSE
TRUNKS (6 SLOTS)			
DTG	4	1	2 DTGS SUPPORTED PER CARD (1 SMU DTG MUST BE USED INTERNALLY) (4x2-1=7 TOTAL)
T1	2	1	2, 24 IST T1S TOWARD DSN AND 2 T1S AS REQUIRED
LOOP NESTS (15 SLOTS)			
2WLTU	2	1	2, 2 WIRE ANALOG LOOPS PER CARD FOR STU-III, POTS (4 TOTAL)
PSHTI	2	1	1, 64 Kbps CIRCUIT PER CARD (2 TOTAL)
DLPMA	4	1	4 DIGITAL TACTICAL LOOPS PER CARD (16 TOTAL)
MFLTU	7	1	2, 4 WIRE SF ISTS PER CARD (14 TOTAL)

10. Joint Voice and Data Network Host Sites

   a. Defense Switch Network Host Locations. Table H-10 shows the location of BWM and switches to which each CONUS and EUR STEP sites will be connected for DSN service.

Table H-10. Locations of DSN BWMs and Switches

STEP SITE	BANDWIDTH MANAGER	DSN SWITCH
LANDSTUHL	LANDSTUHL, GE	VAIHINGEN, GE RAMSTEIN, GE HEIDELBERG, GE
MACDILL	N/A	MACDILL, FL
FORT DETRICK	RESTON, VA	DRANESVILLE, VA
CROUGHTON	CROUGHTON, UK	NAVY LONDON, UK
NORTHWEST	NORFORK, VA	MOSELEY, VA
FORT BRAGG	FAYETTEVILLE, NC	MOSELEY, VA
WAHIAWA	N/A	SCHOFIELD BARRACKS, HI
RAMSTEIN	N/A	RAMSTEIN, GE
FORT BUCKNER	N/A	FORT BUCKNER, JA
LAGO DI PATRIA	LAGO DI PATRIA, IT CAPODICHINO, IT	CAPODICHINO, IT
SWA	N/A	SWA
BAHRAIN	N/A	BAHRAIN, BA
CAMP ROBERTS	SACRAMENTO, CA	SACRAMENTO, CA
FORT BELVOIR	RESTON, VA	PENTAGON CITY, VA
FORT MEADE	RESTON, VA	PENTAGON CITY, VA

b. <u>Red Switch Host Locations</u>. Table H-11 shows the location of DRSN switches to which each STEP site will be connected.

Table H-11. Location of DRSN Hosts

STEP SITE	RED SWITCH HOST
LANDSTUHL	RAMSTEIN, GE (USAFE), DSN 314-480-8444
MACDILL	MACDILL AFB, FL (CENTCOM), DSN 986-6510
FORT DETRICK	PENTAGON (NMCC), COM 703-697-9095
CROUGHTON	NAVY LONDON (NAVEUR), COM 011-44-171-514-4798
NORTHWEST	NORFORK, VA (USJFCOM), DSN 521-6165
FORT BRAGG	SHAW AFB, SC, DSN 965-5830
WAHIAWA	CAMP SMITH, HI (CINCPAC), DSN 315-477-7900 HICKAM AFB, HI
RAMSTEIN	RAMSTEIN, GE (USAFE), DSN 314-480-8400
FORT BUCKNER	YOKOTA, JA (PACAF), DSN 315-225-4059
LAGO DI PATRIA	NAPLES, IT (CAPODICHINO) (NAVEUR), DSN 324-625-3330
SWA	TRAVIS AFB, CA, DSN 837-3820/3821
BAHRAIN	RAMSTEIN, GE (USAFE), DSN 314-480-8400 (BAHRAIN WHEN INSTALLED)
CAMP ROBERTS	TRAVIS AFB, CA, DSN 837-3820/3821
FORT BELVOIR	PENTAGON (NMCC), COM 703-697-9095
FORT MEADE	SITE-R, DSN 988-3481

c. <u>JWICS Host Locations</u>. Table H-12 shows the locations of JWICS hubs to which each STEP site will be connected for JWICS service.

Table H-12. Locations of JWICS Hosts

STEP SITE	JWICS HOST
LANDSTUHL	PATCH BARRACKS, GE (EUCOM)
MACDILL	MACDILL AFB, FL (CENTCOM)
FORT DETRICK	BOLLING AFB (DIA)
CROUGHTON	MOLESWORTH, UK
NORTHWEST	HAMPTON ROADS, VA (USJFCOM)
FORT BRAGG	FORT BRAGG, NC
WAHIAWA	MAKALAPA, HI
RAMSTEIN	PENTAGON
FORT BUCKNER	YOKOTA, JA

Table H-12. (Cont'd)

STEP SITE	JWICS HOST
LAGO DI PATRIA	NAPLES, IT (CAPODICHINO) (NAVEUR)
SWA	SWA
BAHRAIN	BAHRAIN, SA
CAMP ROBERTS	SAN DIEGO, CA (FLTCINCPAC)
FORT BELVOIR	BOLLING AFB (DIA)
FORT MEADE	BOLLING AFB (DIA)

ENCLOSURE I

REFERENCES AND SUPPLEMENTAL READING

PART I--REFERENCES

a. CJCSM 6231.02A, 1 August 1998, Joint Voice Communications Systems.

b. CJCSM 6231.07B, 31 December 1999, Joint Network Management and Control.

c. CJCSM 6231.03A, 15 August 1997, Joint Data Systems.

d. CJCSM 6231.05A, 2 November 1998, Joint Communications Security.

PART II--SUPPLEMENTAL READING

e. TM 11-5895-1465-13&P, 1 September 1991, "Operator's, Unit and Direct Support Maintenance Manual for Modem Communication, MD-1270(P)T" w/Change 1.

f. TM 11-5820-1023-13-1, 1 March 1989, "Operator's, Unit and Direct Support Maintenance Manual for Line-of-Sight Radio Terminal AN/TRC-190(V)" w/Changes 1-3.

g. TM 11-08167A-14-1, "UHF Satellite Terminal, AN/WSC-3."

h. TM 11-5805-726-12-1, 13 September 1985, "Operator's and Organizational Maintenance Manual for Orderwire Control Unit, C-10716" w/Change 1.

i. TM 11-5805-703-14, 16 September 1985, "Operator's, Unit Direct Support and General Support Maintenance Manual, Test Set Telephone, TS-3647" w/Changes 1 and 2.

j. TM 11-7025-221-10, 20 August 1982, "Operator's Manual for Multiplexer Digital, TD-1337."

k. TM 11-5805-706-12, 14 January 1985, "Operator's and Organizational Maintenance Manual for Multiplexer (Remote Loop Group Multiplexer), TD-1233" w/Changes 1 and 2.

l. TM 11-5805-707-12, 14 January 1985, "Operator's and Unit Maintenance Manual for Multiplexer Combiner TD-1234" w/Changes 1 and 2.

m. TM 11-5805-696-12, 17 September 1984, "Operator's and Organizational Maintenance Manual for Multiplexer, TD-1235."

n. TM 11-5805-697-12, 17 September 1984, "Operator's and Unit Maintenance Manual for Multiplexer TD-1236."

o. TM 11-5805-705-12, 17 September 1984, "Operator's and Unit Maintenance Manual for Digital Data Modem, MD-1026."

p. TM 11-5805-699-12, 16 September 1985, "Operator's and Organizational Maintenance Manual for Modem Cable Driver, MD-1023."

q. TM 11-5805-701-12, 5 March 1985, "Operator's and Organizational Maintenance Manual for Restorer Pulse Form, MD-1218."

r. TM 11-5805-698-12, 16 September 1985, "Operator's and Unit Maintenance Manual for Multiplexer, TD-1237."

s. TM 11-5805-700-12, 16 September 1985, "Operator's and Organizational Maintenance Manual for Modem Cable Driver, MD-1024."

t. TM 11-5805-702-12, 5 March 1985, "Operator's and Organizational Maintenance Manual for Restorer, Pulse Form, TD-1219."

u. TM 11-5805-704-12, 7 February 1985, "Operator's and Unit Maintenance Manual, Modem Cable Driver, MD-1025."

v. TM 11-5820-926-34, 13 October 1971, " Direct Support and General Support Maintenance Manual for Radio Repeater Set, AN/TRC-138."

w. TM 11-5820-934-13-1, 1 August 1985, "Combined Operation and Maintenance Instructions Organizational and Intermediate, Radio Terminal Set, AN/TRC-170 (V)2."

x. TM 11-5820-934-13-2, 1 August 1985, "Combined Operation and Maintenance Instructions Organizational and Intermediate, Radio Terminal Set, AN/TRC-170 (V)3."

y. TM 11-5820-865-34, 1 March 1992, "Direct Support and General Support Maintenance Manual for Radio Terminal Set, AN/TRC-173A."

z. TM 11-5820-864-34, 1 January 1989, "Direct Support and General Support Maintenance Manual for Repeater Set, AN/TRC-174()."

aa. TM 11-5829-931-34, 1 January 1989, "Direct Support and General Support Maintenance Manual for Radio Terminal Set, AN/TRC-175()" w/ Change 1.

bb. TM 11-5805-726-12-2, 16 September 1985, "Operator's and Unit Maintenance Manual for Orderwire Control, C-10717/TRC."

cc. TM 11-5820-982-12, 1 March 1987, "Operators and Unit Maintenance Manual for Orderwire Control Unit, C-11643."

dd. TM 11-5895-1433-12-1, 15 September 1991, "Operator's and Organizational Maintenance Manual, Satellite Communications Terminals, AN/TSC-85B(V)."

ee. TM 11-5895-1434-12-1, 15 January 1991, "Operator's and Organizational Maintenance Manual, Satellite Communications Terminal AN/TSC-93B(V)."

ff. TM 11-5895-1465-13&P, 1 September 1991, "Operators, Unit, and Direct Support Maintenance Manual, Modem, Communication, MD-1270(P)/T" w/Change 1.

gg. TM 0844OA-12/2-2, January 1991, "Operator and Organizational Maintenance Manual, Central Office, Telephone, Automatic AN/TTC-42(V)."

hh. TM 08439A-12/2-2, January 1991, "System Interface Switchboard, Telephone, Automatic SB-3865(P)/TTC."

ii. TM 11-5895-1181-10, 15 February 1988, "Operator's Manual, Radio Set AN/VSC-7."

jj. TM 11-5895-1180-10, 15 February 1988, "Operator's Manual, Radio Set, AN/PSC-3."

kk. TM 11-5985-372-13-1, 15 October 1988, "Operator, Unit, and Intermediate Direct Support Maintenance Manual, Quick Reaction Satellite Antenna Group, OE-361(V)."

ll. TO 3lR2-2TSC100-11, 15 June 1986, "Combined Operation and Maintenance Manual, Satellite Communications Terminals AN/TSC-100A(V)."

mm. TO 3lR2-2TSC94-11, 15 June 1986, "Combined Operation and Maintenance Instructions, Satellite Communications Terminals, AN/TSC-94A(V)."

nn. EE130-XX-OMI-010/156-3 USC-38, 31 July 1992, "Preliminary Unvalidated Technical Manual Overall System Manual, Satellite Communication Terminal AN/USC-138(V)."

oo. Naval Space Command, December 1992, "Tactical Super High Frequency Satellite Communications Terminal Concept of Operations."

pp. ECAC-UM-91-045 TTP Release 3.1, August 1991, "EMC Programs for IBM-Compatible Personal Computers: User Manual."

qq. MIL-STD-188-141A, 15 September 1988, "Interoperability and Performance Standards for Medium and High Frequency Radio Equipment."

rr. DISA CONEXPLAN 10-98, June 1998, "DCS Support for Contingency-Exercise Operations."

ss. Harmon, J.V. and Sternowski, R.H., Collins Avionics & Communications Division, Rockwell International, 13 February 1992, "Basic ALE Tutorial."

tt. "Operator's Manual, LST-5C, Lightweight Satellite Transceiver," Motorola Inc.

uu. MSR/TSSR System Specification, PS-1226, Microwave Radio Corporation.

vv. Interface Control Document (ICD)-001A, 28 August 1986, "Voice and Data Orderwire Content and Signaling Information."

ww. TM-11-5895-1589-12&P, December 1996, Operation and Maintenance Instructions for Satellite Communications System, Lightweight Multiband Satellite Terminal (LMST).

xx. Defense Satellite Communications System (DSCS), 12 May 1998, Standardized Tactical Entry Point (STEP) Concept of Operations (CONOPS).

yy. Joint Communications Support Element (JCSE), October 1996, Integrated Digital Network Exchange (IDNX) Concept Of Operations (CONOPS).

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ENCLOSURE J

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Three compact disk (CD) copies of this volume are provided by JIEO DISA, Ft Monmouth, NJ, to each of the following addressees:

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22nd Signal Brigade
24th Signal Battalion
28th Signal Battalion
29th Signal Battalion
32nd Signal Battalion
35th Signal Brigade
39th Signal Battalion
40th Signal Battalion
44th Signal Battalion
50th Signal Battalion
54th signal Battalion
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93rd Signal Brigade
105th Signal Battalion
111th Signal Battalion
112th Signal Battalion

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146th Signal Battalion
151st Signal Battalion
154th Signal Battalion
156th Signal Battalion
212th Signal Battalion
228th Signal Brigade
230th Signal Battalion
234th Signal Battalion
240th Signal Battalion
250th Signal Battalion
279th Signal Battalion
280th Signal Battalion
286th Signal Battalion
304th Signal Battalion
307th Signal Battalion
311th Signal Command
311th Signal Command Forward
319th Signal Battalion
324th Signal Battalion
327th Signal Battalion
335th Theatre Signal Command
359th Signal Brigade
369th Signal Battalion
392nd Signal Battalion
414th Signal Company
442nd Signal Battalion
501st Signal Battalion
516th Signal Brigade
711th Signal Battalion
804th Signal Company
1110th Signal Battalion
1112th Signal Battalion
US Army Forces Command

US Army I Corps
Us Army V Corps
US Army Central Command
US Army Communications Electronics Command
US Army Directorate of Information Systems for Command,
  Control, Communications and Computers
US Army Hi Tech Regional Training Site
US Army Program Manager Military Satellite Communications
US Army Program Manager Warfighter Information Network-
  Tactical
US Army Signal School
US Army Regional Satellite Support Center-Europe
US Army Signal Command
US Army Pacific
US Army Training and Doctrine Command
US Army Special Operations Command

US NAVY

2nd Fleet Commander, N-6
3rd Fleet Commander, N-6
5th Fleet Commander, N6
6th Fleet Commander, N-6
7th Fleet Commander, N-6
Chief of Naval Education and Training
Commander, Amphibious Group 1, N6
Commander, Amphibious Group 2, N6
Commander, Amphibious Group 3, N6
Commander, NAVCOMTELCOM
Commander in Chief Atlantic Fleet, N-6
Commander in Chief Pacific Fleet, N-6
Commander, Naval Air Forces, US Atlantic Fleet, N6
Commander, Naval Air Forces, US Pacific Fleet, N6
Commander in Chief US Navy Europe, London/N-6
Commander in Chief US Navy Europe, Naples/N-6
Commander, Naval Sea Systems Command
Commander, US Naval Forces, Alaska, N6
Commander, US Naval Forces Central, N6
Commander, US Naval Forces, Japan
Commander, US Naval Forces Korea, N6
Commander, Operational Test and Evaluation Force
Commander, Space and Warfare Systems Command
Commanding Officer, Navy Special Warfare Command
Dept of the Navy, CNO, N61,62, 63, 64

Naval Air Systems Command
Naval Communications and Telecommunications Master Station
  Atlantic
Naval Communications and Telecommunications Master Station
  Bahrain
Naval Communications and Telecommunications Master Station
  Guam
Naval Communications and Telecommunications Master Station
  Eurcent Naples
Naval Communications and Telecommunications Master Station
  Pacific
Naval Communications and Telecommunications Master Station
  Puget Sound
Naval Post Graduate School
Naval Sea Systems Command
Naval Space Command
Naval Surface Warfare Center
Naval Special Warfare Group 1
Naval Special Warfare Group 2
Naval Surface Forces Pacific Fleet
Naval Surface Forces Atlantic Fleet
Naval War College
Space and Warfare Systems Command
Space and Warfare Systems Center
USS ABRAHAM LINCOLN, CVN-72
USS BATAAN, LHD-5, COMMUNICATIONS OFFICER
USS BELLEAU-WOOD, LH-3
USS BLUE RIDGE, LCC-19
USS BONNE HOMME RICHARD, LHD-6
USS BOXER, LHD-4
USS CARL VINSON, CVN-70
USS CONSTELLATION, CV-64
USS CORONADO, AGF-11
USS DWIGHT D. EISENHOWER, CVN-69
USS ENTERPRISE, CVN-65
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USS LA SALLE, AGF-3

USS MOUNT WHITNEY, LCC-20
USS NASSAU, LHA-4
USS NIMITZ, CVN-68
USS PELELIU, LHA-5
USS. SAIPAN, LHA-2
USS TARAWA, LHA-1
USS THEODORE ROOSEVELT, CVN-71
USS WASP, LHD-1

US Air Force

1st Combat Communications Squadron
1st Communications Squadron
3rd Combat Communications Group
4th Air Support Operations Group
5th Combat Communications Squadron
8th Air Force
12th Air Force
16th Air Force
18th Communications Squadron
31st Combat Communications Squadron
31st Communications Squadron
32nd Combat Communications Squadron
33rd Combat Communications Squadron
34th Combat Communications Squadron
35th Communications Squadron
48th Communications Squadron
49th Communications Squadron
51st Combat Communications Squadron
52nd Combat Communications Squadron
52nd Communications Squadron
53rd Combat Communications Squadron
54th Combat Communications Squadron
61st Communications Squadron
65th Communications Squadron
71st Air Control Squadron
94th Combat Communications Squadron
103rd Air Control Squadron
107th Air Control Squadron
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114th Combat Communications Squadron
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143rd Combat Communications Squadron
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281st Combat Communications Group

282nd Combat Communications Squadron
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291st Combat Communications Squadron
292nd Combat Communications Squadron
293rd Combat Communications Squadron
319th Communications Squadron
333rd Training Squadron
338th Training Squadron
347th Communications Squadron
354th Communications Squadron
355th Communications Squadron
366th Communications Squadron
375th Combat Support Squadron
505th Tactical Support Squadron
603rd Air Control Squadron
606th Air Control Squadron
607th Air Support Operations Group
607th Combat Communications Squadron
608th Air Communications Squadron
609th Air Communications Squadron
612th Air Communications Squadron
613th Air Communications Squadron
615th Air Mobility Communications Squadron
621st Air Mobility Communications Squadron
682nd Air Support Operations Center
728th Air Communications Squadron
729th Air Communications Squadron
911th Air Lift Wing
914th Combat Communications Squadron
Air Force Communications Agency
Air Force Operational Test and Evaluation Command
Air National Guard Reserve Command
Air Force Space Command
Air Force Special Operations Command
Air Force Electronic Systems Command
Headquarters Air Combat Command
Headquarters US Air Force
Headquarters US Air Force Europe
US Central Command Air Force

US Marine Corps

1st Force Service Support Group
1st Marine Air Wing

1st Marine Division
1st Marine Expeditionary Force
2nd Force Service Support Group
2nd Marine Expeditionary Force
2nd Marine Air Wing
2nd Marine Division
3rd Marine Air Wing
3rd Marine Division
3rd Force Service Support Group
3rd Marine Air Wing
3rd Marine Expeditionary Force
6th Communication Battalion
6th Marine Regiment
7th Communications Battalion
7th Marine Regiment, Reinforced
8th Communications Battalion
9th Communications Battalion
11th Marine Expeditionary Unit
13th Marine Expeditionary Unit
15th Marine Expeditionary Unit
22nd Marine Expeditionary Unit
24th Marine Expeditionary Unit
26th Marine Expeditionary Unit
31st Marine Expeditionary Unit
Expeditionary Warfare Tactical Group, Atlantic
Expeditionary Warfare Tactical Group, Pacific
Marine Corps Air Ground Command
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Marine Corps Reserve Headquarters
Marine Corps Systems Command
Marine Corps Tactical Systems Support Activity
Marine Corps University
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Marine Forces Pacific
Marine Forces Europe
Marine Wing Communications Squadron 18
Marine Wing Communications Squadron 28
Marine Wing Communications Squadron 38
Marine Wing Communications Squadron 48

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224th Joint Communications Support Squadron
290th Joint Communications Support Squadron
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US Forces Korea
Armed Forces Staff College
Headquarters Alaskan Command
Headquarters Special Operations Command Europe
Headquarters Special Operations Command South
Headquarters Special Operations Command Central
Joint Communications Support Element
Executive Agent, Theater Joint Tactical Networks
Joint Battle Center
Joint Staff Intra Theater COMSEC Manager
Joint Task Force Systems Course Manager

Defense Agencies
Defense Information Systems Agency
National Security Agency

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GLOSSARY

ABBREVIATIONS AND ACRONYMS

AADCOM	Army Air Defense Command
AAT	automatic analog test
AAU	analog applique unit
ABNCP	airborne command post
AC	alternating current
ACC	Air Combat Command
ACU	antenna control unit
A/D	analog-to-digital
ADA	air defense artillery
ADIMSS	Automated DSN Integrated Management Support System
ADMS	automated digital multiplexing system
ADP	automatic data processing
ADPCM	adaptive delta pulse code modulation
ADT	automatic digital test
AFC	automatic frequency control
AFFOR	Air Force forces
AFSATCOM	Air Force satellite communications
AFSOF	Air Force special operations forces
A/G	air to ground
AIRCOMTERM	air communications terminal
AJ	antijam
AJCM	AJ control modem
ALE	automatic link establishment
ALQA	automatic link quality assessment
AME	antenna mounted electronics
AMI	alternate mark inversion
AMPSSO	automated message processing system security officer
ANDVT	advanced narrowband digital voice terminal
AOCU	analog orderwire control unit
APCU	antenna position control unit
AROW	acquisition/reportback orderwire
APS	auxiliary propulsion subsystem
ARFOR	Army forces
ARSOF	Army special operations forces
ASAS	All Source Analysis System
ASCT	auxiliary satellite control terminal
ASI	alarm status indicator
ASK	amplitude shift keying
ASY	asynchronous
ATACS	Army Tactical Communications System
ATDM	adaptive time division multiplexer
ATFES	Army tactical frequency engineering system
ATM	asynchronous transfer mode
AUTODIN	Automatic Digital Network
AUX	auxiliary
AVDTG	AUTOVON digital trunk group

AVOW	analog voice orderwire
AWG	American wire gauge
B/B	baseband
BCN	beacon
BER	bit error rate
BEZS	bandwidth efficient zero suppression
BITE	built in test equipment
BLOS	beyond line-of-sight
BOH	bottom of hill
BOI	basic operator interface
bps	bits per second
BPSK	binary phase-shift keying
BSC	BLACK station clock
BSC RO	BLACK station clock receive out
BWM	bandwidth manager
BX	bus extender
CAFMS	computer assisted force management system
CAS	crew assignment sheet
CB	common battery
CBFS	cesium beam frequency standard
CCA	circuit card assembly
CCC	critical control circuit
CCES	contingency communications extension switch
CCP	contingency communications package
CCPS	contingency communications parent switch
CCS	constellation control stations
CCSD	control communications service designator
CDA	conditioned diphase adapter
CDGS	conditioned diphase group signal
CDϕ	conditioned diphase
CDM	cable driver modem
CDMA	code division multiple access
CD-ROM	compact disc-read only memory
CECOM	Communications and Electronics Command
CEG	communications equipment group
CEOI	communications-electronics operating Instructions
CELP	code excited linear prediction
CEPT	Conference of Postal and European Telecommunications
CESE	communications equipment support element
CHIMPS	Chirpsounder integrated MUF prediction system
CHK	check
CHNL	channel
c/kT	ratio of average carrier power to noise power spectral density
CIB	communications information bulletins
CIC	communications interface controller
CINC	commander of a combatant command

CJTF	commander joint task force
CLS	crosslink subsystem
CM	control modem
CMA	control monitor alarm
CMX	circuit multiplexer
CNCE	communications nodal control element
CODEC	coder/decoder
COMM	communications
COMSEC	Communications Security
COSCOM	corps support command
COTS	commercial-off-the-shelf
COU	cable orderwire unit
COW	control orderwire
CPFSK	continuous-phase frequency shift keying
CPP	point-to-point analysis
CRC	control and reporting center
CRF	channel reassignment function
CRS	circuit switch routing
CS	circuit switch
CSCE	communications systems control element
CSCI	commercial satellite communications initiative
CSF	configuration strapping function
CSPC	call service position console
CSS	communications subsystem
CSU	channel service unit
CT	control telemetry, cipher text
CTAPS	contingency TACS automated planning system
CTID	communications transmission identifier CTT-H/R commanders tactical terminal-hybrid/receive
CVSD	continuously variable slope delta
CW	continuous wave
C2	uplink network control
C^2	command and control
C3	downlink network control
C4I	Command, Control, Communications, Computers, and Intelligence
D/A	digital-to-analog
DACS	digital analog cross-connect system
DAMA	demand assigned multiple access
DAMP	DGM antenna mast program
DAR	distortion adaptive receiver
DAS	direct access subscriber
dB	decibel
dBi	decibels above isotropic reference
dBm	decibels referred to one milliWatt
dBW	decibels referred to one Watt
DC	direct current
D/C	downconverter
DCE	date communications equipment
DCM	data channel multiplexer

DCPG	digital clock pulse generator
DCS	Defense Communications System
DCSCU	dual capability servo control unit
DCSS	Digital Communications Satellite Subsystem
DCW	Digital Chart of the World
DDM	digital data modem
DDN	Defense Data Network
DDS	digital data service
DEMUX	demultiplex
DES	downsized extension switch
DEUCE	downsized end user computer equipment
DGM	digital group multiplexer
DIG	digital
DIS	disable
DISA	Defense Information Systems Agency
DISNET	Defense Integrated Secure Network
D/L	downlink
DLG	digital loop group
DLPMA	diphase loop modem A
DLTU	digital line termination unit
DM	data modem
DMD	digital multiple drop
DMDG	digital message device group
DMS	Defense Message System
DNI	digital NATO interface
DNVT	digital nonsecure voice terminal
DOC	Department of Commerce
DOW	data orderwire
DPA	dual phone adapter
DPP	data patch panel
DPS	data processing subsystem
DR	digital radio
DRSN	Defense Red Switch Network
DSCS	Defense Satellite Communications System
DSN	Defense Switched Network
DSNET	Defense Secure Network
DSP	digital speech processor
DSU	data service unit
DSVT	digital subscriber voice terminal
DTA	dual trunk adapter
DTE	digital data terminal
DTED	digital terrain elevation data
DTG	digital transmission group
DTH	down-the-hill
DTMF	dual tone multifrequency
DVOW	digital voice orderwire
EA	each
EAC	echelons above corps
E&M	ear and mouth
E_b/N_o	energy per bit/noise spectral density
ECB	echelons corps and below

ECU	environmental control unit
EHF	extremely high frequency
EIRP	effective isotopic radiated power
EMLTU	E&M line termination unit
ENA	enable
EOL	end of link
EOW	engineering orderwire
EOWSP	EOW signal processor
EPDS	electrical power and distribution system
ETSSP	enhanced tactical satellite signal processor
ETUT	enhanced tactical user terminal
EX	expansion shelf
EXT	external
FAA	Federal Aviation Administration
FACP	forward air control party
FAX	facsimile
FDM	frequency division multiplex
FDS	fault detection system
FDX	full duplex
FEC	forward error correction
FED-STD	Federal Standard
FEP	front end processor
FIFO	first in first out
FLTSATCOM	fleet satellite communications
FLTBCST	fleet broadcast
FLTCINC	fleet commander in chief
FM	frequency modulation
FO	fiber optic
FOA	fiber optic applique
FOCA	fiber optic cable assembly
FOCS	fiber optic cable system
FOIU	fiber optic interface unit
FOM	fiber optic modem
FORGN	foreign
FOT	frequency of optimum transmission
FOTS	fiber optic transmission system
FSK	frequency shift keying
ft	foot, feet
FXO	foreign exchange office
FXS	foreign exchange station
GAR	gateway access request
GBS	global broadcast system
GCCS	Global Command and Control System
GFE	government furnished equipment
GHz	gigaHertz
GM	group modem
GMF	ground mobile forces
GNDCP	ground command post
GNDFE	ground force element

GPEE	general purpose encryption equipment
GPMDM	group modem
GPS	global positioning satellite
G/T	antenna gain-to-noise temperature
GTFM	generalized tamed frequency modulation
GW	gateway
GWC	global weather central
HDVC	high density voice compression
HF	high frequency
HFPLAN	HF planner
HI	high
HMMWV	high-mobility multipurpose wheeled vehicle
HOC	cable connector
HPC	high-performance controller
HPA	high-power amplifier
HS	high-speed
HSCDM	high-speed cable driver modem
HSD	high-speed synchronous data
HSPR	high-speed pulse restorer
HSS	high-speed shelf
HSSDB	high-speed serial data buffer
HT/MT	heavy terminal/medium terminal
HVPS	high-voltage power supply
Hz	Hertz
HZG	Hertz generator
IAS	intelligence analysis system
IBC	in-band control
ICF	interconnect facility
ID	identification
IDF	intermediate distribution frame
IDNX	integrated digital network exchange
IEEE	Institute of Electrical and Electronics Engineers
IEMATS	Improved Emergency Actions Automatic Transmission System
IEW	intelligence/electronic warfare
IF	intermediate frequency
IJC3S	integrated joint command and control communications system
INMS	integrated network management system
INT	internal
IP	internet protocol
ISB	independent sideband
ISO	isochronous
ISDN	Integrated Services Digital Network
ISDNX	Integrated Services Digital Network Exchange
ISR	initial service request
ITSND	Integrated Tactical-to-Strategic Data Networking
ITU	International Telecommunications Union

ITW/AA	integrated tactical warning/attack assessment
ITW&A	integrated tactical warning and attack
IWS	Interoperable Waveform Standard
JCSE	Joint Communications Support Element
JDIICS-D	Joint Defense Information Infrastructure Control System deployed
JDISS	Joint Deployable Intelligence Support System
JFC	joint force commander
JIEO	Joint Information and Engineering Organization
JOPES	Joint Operation Planning and Execution System
JSOTF	joint special operations task force
JTC3A	Joint Tactical Command, Control, and Communications Agency
JTF	joint task force
JVDN	joint voice and data networks
JWG	Joint Working Group
JWICS	Joint Worldwide Intelligence Communications System
K	Kelvin
Kbps	kilobits per second
kHz	kiloHertz
km	kilometers
kVA	kilovolt ampere
kW	kilowatt
LAN	local area network
LANTDIS	Atlantic Command deployable intelligence terminal
LBO	line built out
LCC	link communications circuit
LCU	lightweight computer unit
LDR	low data rate
LD-CELP	Low Delay - Code Excited Linear Prediction
LDRM	low data rate multiplexer
LED	light emitting diode
LEN	large extension node
LENS	large extension node switch
LGM	loop group multiplexer
LIU	line interface unit
LKG	loop key generator
LMD	loop group multiplexer and demultiplexer
LMST	lightweight multiband satellite terminal
LNA	low noise amplifier
LO	low
LOI	loss-of-input
LOS	line of sight

LOW	link orderwire
LPD	low probability of detection
LPI	low probability of interception
LQA	link quality analysis
LRDM	low rate data multiplexer
LRM	low rate multiplexer
LRU	line replacement unit
LSB	lower sideband
LSCDM	low speed cable driver modem
LSPR	low speed pulse restorer
LSTDM	low speed time division multiplexers
LTG	local timing generator
LTU	line termination unit
LUF	lowest usable frequency
LWX	LAN/WAN exchange
LZ	landing zone
m	meters
MA	master
mA	milliampere
MAGTF	Marine air ground task force
MARCEMP	manual relay center modernization program
MARFOR	Marine forces
MAX	maximum
MB	megabytes
Mbps	megabits per second
MCDN	Marine Corps Data network
MCE	mission control element
MCS	mission control segment
MCTSSA	Marine Corps systems support activity
MDE	mission development element
MDF	main distribution frame
MDR	medium data rate
MED	Mediterranean
MEF	Marine Expeditionary Force
MF	management facility
MFLTU	multifrequency line termination unit
MG	master group
MGM	master group multiplexer
MHz	megahertz
MIDAS	Multiplexer Integration and DCSS Automation System
MILDEPS	Military departments
Milstar	Military Strategic and Tactical Relay
MIL-STD	Military Standard
MMI	man/machine interface
MOC	Milstar operations center
MOE	mission operations element
MOF	maximum observed frequency
MOW	maintenance orderwire
MPE	mission planning element
MRC	major regional conflict

MRT	mobile radio telephone
MRVC	multirate voice card
MS	message switch
ms	millisecond
MSE	mobile subscriber equipment
MSF	multiplex signal format
MSRT	mobile subscriber radio terminal
MTF	message text format
MTG	master timing generator
MUF	maximum usable frequency
MUX	multiplex
mw	milliwatt
MWP	microwave processor
MXDMX	multiplex/demultiplex
NAI	NATO analog interface
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVCAMS	naval modular automated communications system
NAVCOMPARS	Navy Communications Processing and Routing System
NAVFOR	Navy forces
NAVMACS	Navy modular automated communications system
NAVTACNET	Navy Tactical network
NB	narrowband
NBS	National Bureau of Standards
NC	node center
NCA	National Command Authorities
NCE	network control element
NCMD	nine channel multiplexer demultiplexer
NCS	node center switch
NCT	network control terminal
NCTAMS	Naval Computer and Telecommunications Area Master Station
NILTU	NATO interface line termination unit
NIPRNET	unclassified-but-sensitive internet protocol router network
NMT	nodal mesh terminal
NOC	Network operation center
NNT	nonnodal terminal
NR/C	Nonredundant COMSEC capable
NR/NC	Nonredundant not COMSEC capable
NRZ	nonreturn to zero
ns	nanosecond
NST	Navy standard teleprinter
NT	nodal terminal
NTP	Naval Telecommunications publication
NVIS	near vertical incident skywave
O&M	Operations and maintenance

OCD	orderwire clock distributor
OCU	orderwire control unit
OH	overhead
OIU	operation interface unit
OMT	orthogonal mode transducer
OPE	operational planning element
OQPSK	offset quadriphase shift keying
OSAT	out-of-service analog test
OSF	operations support facility
OTAR	over-the-air rekeying
O/W	orderwire
PAM	pulse amplitude modulation
PBX	private branch exchange
PCA	printed card assembly
PCM	pulse code modulation
PDC	program designator code
PDSS	post deployment software support
PDU	power distribution unit
PGE	power generation equipment
PHS	primary HMMWV Shelter
PLL	phase lock loop
PLRS	position location and reporting system
PLRSMAN	PLRS manager
PN	pseudorandom noise
P/N	part number
POC	point of contact
POP	point of presence
P/O	part of
P/P	patch panel
p-p	peak-to-peak
ppm	pulses per minute
PR	pulse repeater
PRC	primary rate card
PS	packet switch
PSHTI	packet switch host trunk interface
PSK	phase shift keying
PSTN	public switched telephone system
PT	plain text
PTP	point-to-point
PTT	push-to-talk
PU	purpose and use
PVT	private
QASD	quad asynchronous/synchronous data
QAVP	quad analog voice port
QEEM	quick erect expandable mast
QPSK	quadriphase shift keying
QRA	quick reaction antenna
QRSAG	quick reaction satellite antenna group
QXP	quad X.21 port

RAM	random access memory
RAU	radio access unit
RB STD	rubidium standard
RBECS	revised battlefield electronic communications-electronics operation instruction system
R/C	Redundant capable
RCA	radio coverage analysis
RBI	RED-BLACK interface
RCL	received carrier level
RCTC	receive cipher text clock
RCU	remote control unit
RCV	receive
RX	receive
RDJTF	rapid deployment joint task force
R/NC	Redundant Not COMSEC capable
RF	radio frequency
RI	routing indicator
RLGM	remote loop group multiplexer
RLGM/CD	remote loop group multiplexer/cable driver
RM	radio modem
RMC	remote multiplexer combiner
ROCU	remote orderwire control unit
RPTC	receive plain text clock
RR	receiver-ready
RS	rate synthesizer
RSC	RED station clock
RSS	radio subsystem
R/T	receive/transmit
RTCU	remote terminal control unit
RTM	real-time mode
RXCLKIN	receive clock in
RXREF	receive reference
SA	standalone
SAA	satellite access authorization
SACS	satellite mission control subsystem
SALTS	streamlined alternative logistic transmission system
SAM	SPEED applications manager
SAR	satellite access request
SAT	satellite relay
SATCOM	satellite communications
SATPLAN	satellite analysis
SAU	servo amplifier unit
SAW	surface acoustic wave
SBPSK	shaped beam phase shift keying
SC	station clock
SCAMP	Single Channel Antijam ManPortable Terminal
SCC	system control center
SCI	sensitive compartmented information
SCIF	sensitive compartmentalized information facility

SCLP	signaling channel link protocol
SCPC	single channel per carrier
SCS	stabilization and control subsystem
SD	send data
SDMX	space division matrix
SDSG	space division switching group
SELCALL	selective call
SEN	small extension node
SENS	small extension node switch
SEP	signal entrance panel
SG	supergroup
SGLS	space-ground link subsystem
SHF	super high frequency
SI	special intelligence
SID	station ID
SINAD	$\dfrac{\text{signal+noise+distortion}}{\text{noise+distortion}}$
SINCGARS	single channel ground and airborne radio system
SIPRNET	SECRET internet protocol router network
SMART-T	Secure, Mobile, Antijam, Reliable Tactical Terminal
SMCS	satellite mission control subsystem
SMR	specialized mobile radio
SMU	switch multiplexer unit
SMX	satellite multiplexer
S/N	signal-to-noise ratio
SNAP	switched network automated planner
SNMP	simple network management protocol
SOC	special operations command
SPD	speed
SPEED	system planning, engineering, and evaluation device
SPP	SPEED path profiler
SQL	structured query language
SRWBR	short range wideband radio
SSB	single sideband
ST	send timing
STA CLK	station clock
STA ID	station identification number
STAR-T	SHF Tri-Band Advanced Range Extension Terminal
STDIS	space division timing distributor
STEP	standard tactical entry point
STGEN	space division matrix timing generator
STS	standard shelf
STU	secure telephone unit
SUPCOM	support command
SURTASS	surveillance towed array sensor system SYN synchronous
SX	switch exchange
TACC	tactical air control center

TACSAT	tactical satellite
TACTERM	tactical terminal
TADIL	tactical digital link
TBSL	to be supplied later
TC	telemetry combiners
TCF	technical control facility
TCLTU	twenty hertz line termination unit
TCP	terminal control processor
TCS	thermal control subsystem
TCU	terminal control unit
TD	timing distributor
TDM	time division multiplexing
TDMS	time division matrix
TDMX	time division multiplexer
TDSGM	time division switch group modified
TED	trunk encryption device
TESS	tactical environment support system
TGASC	timing generator automatic signaling card
TGM	trunk group multiplexer
TGMOW	transmission group module orderwire
TIMTG	timing generator
TIREM	terrain-integrated rough-earth model
TM	tropo modem
TMCP	two-megabit channelized port
TMG	timing
TDIST	tactical digital interswitch trunk
TNAPS+	tactical network analysis and planning system plus
TOCU	tropo orderwire control unit
TOD	time-of-day
TOH	top of hill
TPSN	tactical packet switch network
TR	terminal ready
TRANSEC	Transmission Security
TRAP	terrain resources analysis program
TR GNDCP	transportable ground command post
TRI-TAC	Tri-Service tactical communications program
TRK	trunk
TROPO	tropospheric scatter
TSO	telecommunications service order
TSR	telecommunications services request
TSSP	tactical satellite signal processor
TSSR	tropo-satellite support radio
TT	terminal timing
TT&C	tracking, telemetry, and command
TTL	transistor-to-transistor logic
TTY	teletype
TWTA	traveling wave tube amplifier
TXCLKIN	transmit clock in
TXIN	transmit in
TXREF	transmit reference

U/C	upconverter
UHF	ultra high frequency
U/L	uplink
ULCS	unit level circuit switch
ULMS	unit level message switch
UMS	universal modem system
USAISC	US Army Information Systems Command
USB	upper sideband
USD	universal synchronous data
USJFCOM	US Joint Forces Command
USMTF	United States MTF
v	volts
VAC	volts alternating current
VC	voice compressor
VCC	voice communications circuit
VCO	voltage-controlled oscillator
VCXO	voltage-controlled crystal oscillator
VDC	volts direct current
VDR	voice digitation rate
VDU	video display unit
VF	voice frequency
VFCT	voice frequency carrier telegraph
VFTG	voice frequency telegraph
VHF	very high frequency
VOCU	voice orderwire control unit
V p-p	volts peak-to-peak
VSP	voice selection panel
VSWR	voltage standing wave ratio
VT	virtual terminal
VTC	video teleconferencing
W	Watts
WB	wideband
WLTU	wire line termination unit
WOTL	worldwide topographic loader
WVS	world vector shoreline
X/L	cross link
XMIT	transmit
XMT	transmit